THE ENGINEER

A Seven-Day Journal

The Engineering, Marine and Welding Exhibition

As recorded in our last issue, the Engineering, Marine and Welding Exhibition was officially opened at Olympia, London, on Thursday, August 30th, by the honorary president, Engineer Vice-Admiral Sir Harold Brown. At a luncheon which followed the opening, the toast, "Success to the Exhibition," was proposed by Mr. Keith Fraser, president of the British Engineers' Association. In the course of his speech, Mr. Fraser said that the British engineering industry showed in the exhibition, to the visitor from abroad, not only something of the tremendous variety of its products, but something of the widely differing sizes of companies involved. This country's engineering industry had been built up over many generations; it had survived many wars and many Governments, and would go on doing so. Replying to the toast, Sir Harold Brown claimed that the exhibition was an emblem not only of this country's world-renowned craftsmanship, energy and enterprise, but an emblem that British engineers had faith and confidence in the future of the country. Commenting on the rearmament programme, Sir Harold suggested that it had two aspects which were the actual provision of the weapons, and the maintenance of a strong economy. For both aspects, he said, the engineering industry carried the major responsibility, first in the actual manufacture of the complicated weapons and equipment required by all three Services, and, secondly, in providing the exports on which this country's economy so largely depended.

Employment of Engineers by Local Authorities

THE Engineers' Guild has been endeavouring to obtain from the Durham County Council an assurance that chartered civil, mechanical and electrical engineers, whether applying for posts or already in the Council's employ, shall be exempt from questioning about membership of a trade union or other appropriate professional organisation. This assurance has not been forthcoming, and the Guild has therefore written to the Minister of Transport informing him of the circumstances, and reminding him of his reply to a question in Parliament on June 18th about similar conditions being enforced by the Borough of Edmonton. That reply was to the effect that the Minister declared compulsory trade union membership to be incompatible with the conditions under which he made a grant from the Road Fund to the engineer's salary. The council of the Engineers' Guild believes that professional engineers employed by the Durham County Council are subjected to compulsory trade union membership. The Minister of Transport has therefore been asked if he will cease to pay from the Road Fund the grant which is made towards the salary of the Durham county engineer.

Eighth International Congress of Refrigeration

THE eighth International Congress of Refrigeration was opened in London on Wednesday afternoon of last week, and the meetings of its seven commissions, for the discussion of technical papers, proceeded until Tuesday last. The rest of the programme consists mainly of visits to works, research establishments and other places of interest, which will continue until Monday next, September 10th. The congress is held under the auspices of the International Intitute of Refrigeration, and the organisation this year has been undertaken by the British Institute of Refrigeration. The last International Congress was held at The Hague in June, 1936. The congress banquet took place on Tuesday evening last at the Connaught Rooms, London, when a large company of delegates and guests assembled under the chairmanship of Viscount Bruce of Melbourne, the congress president. The toast of "The Congress" was given by Mr. J. McEwen, Minister of Commerce, Australia, who said that there were probably no countries in the world more dependent, for the success of their commerce, upon refrigeration than Australia and New Zealand. He was glad that there was increasing recognition of the fact that refrigeration occupied a tremendously important place in modern civilisation. After a response by Lord Bruce, the toast of "The Overseas Visitors" was proposed by Mr. W. S. Douglas, chairman of the organising committee of the Congress, and acknowledged by Mr. P. B. Christensen, president of the American Society of Refrigerating Engineers, and Monsieur A. Blanc, Director-General of Engineering Services in the French Ministry of Agriculture.

Inauguration of the Chingford South Reservoir

ON Tuesday last, September 4th, the Metropolitan Water Board's Chingford South reservoir in the Lee Valley was officially inaugurated. The opening ceremony was performed by the chairman of the Board, Mr. W. H. Girling, after whom the reservoir has been named. The reservoir is the last one which the Board had powers to build in the Lee Valley; its construction was started in 1935, but in 1937 constructional difficulties necessitated its redesign, and a consequent variation in the contract. At the outbreak of the war, most of the plant was requisitioned, the greater part of the labour force withdrawn, and progress brought almost to a standstill. In spite of these obstacles, however, the work has now been carried forward to completion. The reservoir is one of the largest in the Board's possession, having a perimeter of 3½ miles, a water surface area of 334 acres, and a capacity of some 3400 million gallons. It has been constructed to the designs of Sir Jonathan Davidson, formerly chief engineer of the Board, the contractors being John Mowlem and Co., Ltd. The total estimated cost of the reservoir is about £2,334,000; it consists of an earthen embankment some 35ft in height around the perimeter, with a puddle-clay core, and with a concrete lining on its inner slopes, the inlet and outlet works being at opposite ends.

Machine Tools and Other Equipment for the Rearmament Programme

THE tenth report from the Select Committee on Estimates, which was published at the end of last week, and which deals with this country's rearmament programme, says that delivery dates of machine tools, even of those ordered in good time from the U.S.A. by the Ministry of Supply, have recently tended to slip back. The Machine Tool Trades Association considers, however, that delayed deliveries will chiefly affect the private user, as the Ministry's policy is to divert tools away from firms which have no defence contracts. The report states that 35,000 machine tools are required for defence purposes and that firm demands have been received for about 31,000. Of the total requirement, 8000 to 9000 tools will be obtained from the U.S.A., where 6988 have already been ordered at an estimated cost of £52,825,000, and from Europe 10,443 machine tools have been ordered at an estimated cost of £39,293,000. Orders for about 8000 machine tools have been placed with United Kingdom producers, and the balance will be obtained by diverting, from existing home and export customers, tools already ordered. The report also mentions that evidence from the Admiralty, the War Office and the Ministry of Supply which was submitted to the Committee indicates that delivery of equipment, including aircraft, is rather behind hand, but that improvements are hoped for as a result of measures for allocating raw materials.

International Congress on Astronautics

THE second International Congress on Astronautics is being held in London this week. It has been organised by the British Interplanetary Society, which was founded in 1933 to promote the development of interplanetary exploration and communication by the study of rocket engineering, astronomy and other associated sciences. The congress is receiving the support of most of the organisations in the world interested in the new science of space flight and is being attended by delegates from this country, Canada, the U.S.A., France, Germany, Austria, Denmark, Spain, Argentina, Sweden, Switzerland, Holland and Italy. The proceedings on the first two days, Monday and Tuesday last, were in private, but it is stated that proposals were discussed for setting up an International Astronautical Federation to include all societies working in the field of space flight. At succeeding technical sessions, open to the public, there have been discussions on papers dealing with the "earth-satellite-vehicle," or "space-station," which is now generally believed to be the key to the problem of space travel. The final session of the congress is to be held to-morrow, Saturday, afternoon, at the Caxton Hall, Westminster. It will consist of a popular technical symposium in which spokesmen from the various national delegations will each give short talks explaining their ideas on the technical solutions to the general problem of interplanetary flight.

Metropolitan-Vickers Appointments

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., has announced the appointment of Dr. C. Dannatt, M.I.E.E., as director of research and education, in place of Sir Arthur Fleming, who is relinquishing that office, but who will continue to serve on the board. Sir Arthur has been appointed director of research and education of Associated Electrical Industries, Ltd. Dr. Dannatt, who is a director of the company and chief electrical engineer, also becomes assistant managing director. He received his technical education under Professor W. M. Thornton at Armstrong College, Newcastle upon Tyne, from which he graduated in electrical engineering in 1921. In the same year he joined Metropolitan-Vickers as a college apprentice. In August, 1940, Dr. Dannatt was appointed to the Chair of Electrical Engineering in the University of Birmingham, but at the request of the Admiralty he continued part-time activities with the Metropolitan-Vickers Company. He returned to the full-time service of the company in 1944, becoming deputy chief electrical engineer in 1945, and chief electrical engineer and a director in 1947. Mr. H. West, M.I.Mech.E., M.I.E.E., at present assistant chief electrical engineer, succeeds Dr. Dannatt as chief electrical engineer, and has also been appointed a director.

The Engineering and Marine Exhibition

No. II—(*Continued from page 261, August 31st*)

IN this article we describe a further selection of the exhibits to be seen at the exhibition which is open at Olympia on weekdays, until Sept. 13th, from 10 a.m. to 8 p.m.

F. J. Edwards and Co., Ltd.

The large selection of the standard range of sheet metal working and other machines exhibited by F. J. Edwards and Co., Ltd., of 359, Euston Road, London, N.W.1, includes a number of machines of improved and new design.

One of the recently introduced machines is the universal punching, shearing, section cropping, and notching machine, illustrated in Fig. 9, which is the largest portable unit of this type made by the firm. The main body of this machine is constructed of heavy cast steel sections and the drive is by a 3 h.p., 2800 r.p.m. motor giving thirty working strokes a minute. It is fitted with high-grade alloy steel shearing blades, capable of splitting steel plate up to $\frac{5}{16}$in thickness of any length or width in successive cuts. Accuracy of operation is assured by a cutting line indicator and an adjustable hold-down clamp. The blades will shear flat bars up to $\frac{3}{4}$in thick and the front end of the lower blade is bevelled to facilitate mitre cutting and notching of tee and angle sections.

Mounted above the plate shears are two "slip-in" blades for cutting up to $1\frac{5}{16}$in round or $1\frac{3}{4}$in square bars, and other shaped sections may also be cut if these blades are provided with suitable apertures. An adjustable hold-down is fitted; the blades, however, are not secured in any way; they slide into position for cutting square sections or may be reversed and returned to position, when they are immediately ready for cutting rounds.

The angle and tee cropping mechanism is arranged in the centre of the machine and with it sections up to 4in by 4in by $\frac{3}{4}$in can be cropped at right angles, while at 45 deg. the cutting capacity is 3in by 3in by $\frac{3}{4}$in. Self-accommodating clamps guide the work as it passes through the aperture, ensuring a clean and undistorted cut. The hold-down and guide is adjustable on a graduated slide for bevel cutting from 45 deg. to 90 deg.

In the punch and notching head at the opposite end of the machine both tools are controlled by the same clutch. A rectangular notching tool is normally supplied, which will also make mitre notches in angles, tees, joists, channels and plates. Location of the punching tool is by means of a handwheel, and a stripper and adjustable guide for punching holes in the edge of steel sheet are provided.

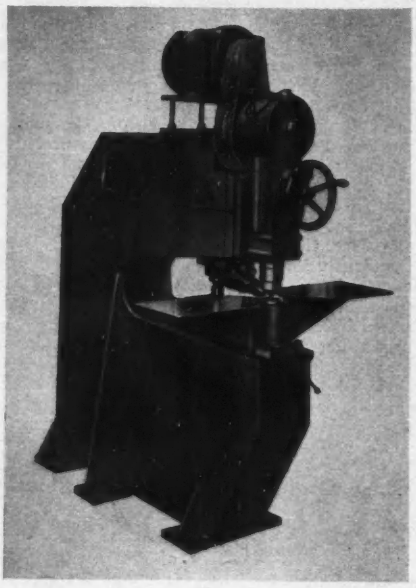


FIG. 10—HIGH SPEED NIBBLING MACHINE—EDWARDS

Another machine on this stand, stated to be of entirely new design, is the "Besco" production high-speed nibbling machine, illustrated in Fig. 10, which has a cutting capacity of up to $\frac{5}{16}$in mild steel. It has a fabricated steel plate body and is arranged for direct floor mounting. The throat gap of the machine is 32in and it is provided with two large work support tables.

The machine is driven through two-speed vee rope pulleys by a 2 h.p. motor, and a counterbalanced flywheel regulates the movement of the eccentric shaft which is mounted on taper roller bearings. The balanced piston ram runs in long phosphor-bronze bearings at a speed of 720 to 1000 strokes per minute. This ram is adjustable for height to permit cutting on the inside edge of the blank after pre-punching, through mitre gears by means of a handwheel placed in a convenient position on the front of the head. The punch is held in a collet chuck, which can be turned to cut in any direction.

A stripper for clearing work from the punch is mounted on a slide in the throat of the machine and is combined with a circle cutting device capable of cutting discs or rings up to 30in in diameter from blanks from which the corners have been removed. The maximum size circle that can be cut from the square blank is 22in diameter, with a minimum of 7in diameter.

The "Besco" hand punch made by the firm is designed with a narrow body to facilitate punching in inaccessible places.

It is produced in two sizes with gaps of $2\frac{1}{4}$in and $3\frac{1}{4}$in respectively and supplied with a standard punching equipment. This tool will shear a hole of $^{7}/_{32}$in diameter through mild steel sheet of 16 S.W.G., whilst a larger model will punch the same size hole in 14 S.W.G. sheet. Extra punches and dies of $\frac{1}{16}$in, $^{3}/_{32}$in, $\frac{1}{8}$in, $^{5}/_{32}$in, and $\frac{3}{16}$in diameter are available for both tools.

Keith Blackman, Ltd.

In addition to a range of fans for most industrial purposes, a compact air-conditioning unit, for cleaning, warming or cooling, and either humidifying or dehumidifying the air supply to large buildings, is shown upon the stand of Keith Blackman, Ltd., of Mill Mead Road, London, N.17.

These units are made in a number of sizes according to requirements, and the arrangement of that exhibited at Olympia can be seen in Fig. 11. It has one of the maker's "21 EK" centrifugal fans suitable for supplying some 4000 cubic feet per minute of air against 1in W.G. when the motor is running at 710 r.p.m. The air washer, which is fitted with a transparent side to show the arrangement of the interior of the unit, is 5ft 6in long and has a single bank of atomiser nozzles. The air washer is supplied by a centrifugal motor-driven pump.

A preheater with a single-row, copper-

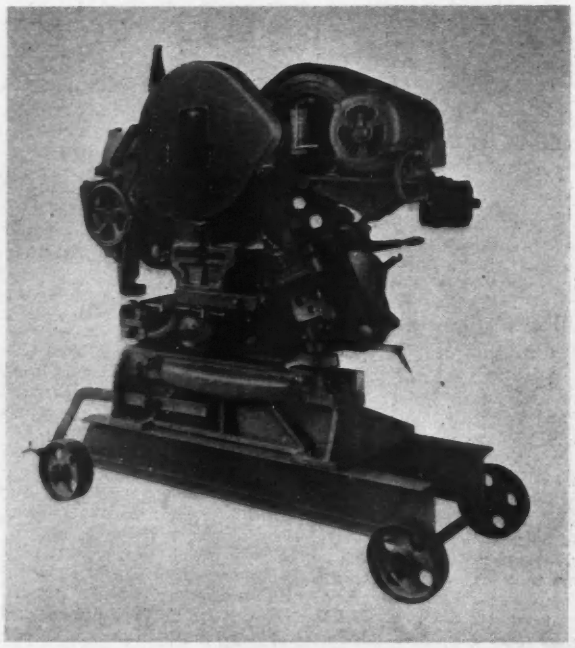


FIG. 9—UNIVERSAL PUNCHING, SHEARING, CROPPING MACHINE—EDWARDS

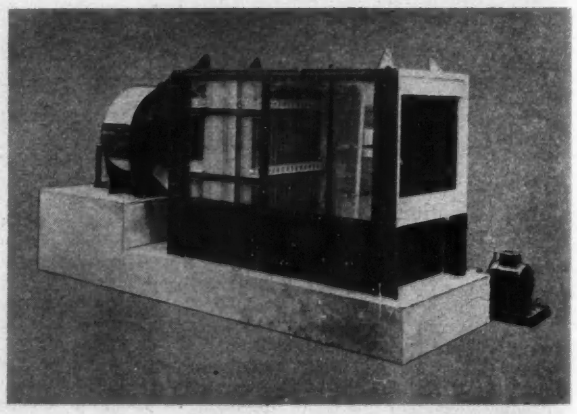


FIG 11—AIR CONDITIONING UNIT—KEITH BLACKMAN

gilled tube section, is bolted directly to the air washer inlet, and the main heater, which has two rows of tubes, is bolted to the air washer outlet.

Crossley Brothers, Ltd.

Crossley Brothers, Ltd., of Manchester, shows on one of its stands four engines representative of the range built by the company and, on the second stand, three-quarter scale models of engines. The largest exhibit is a 3000 b.h.p. marine installation (Fig. 12) consisting of two Mark "CRL8" diesel engines geared to a single propeller shaft through electromagnetic couplings. Each engine has eight cylinders and develops 1500 b.h.p. at 320 r.p.m., and drives through a reduction gear of 2½ to 1 to give a propeller speed of 128 r.p.m. The length of the complete unit is 31ft and both engines are of the same hand, rotate in the same direction and are manœuvred simultaneously from a single control. At normal rating of 1500 b.h.p. the b.m.e.p. is 74·2 lb per square inch and the direct-injection, two-cycle, direct-reversing scavenge pump diesel engine has a bore of 14·5in by 19in stroke. Starting and reversal is by compressed air, which is led to each cylinder by a separate branch pipe from a rotary starting air distributor and exhaust pulse pressure charging is incorporated. The direct reversing gear is integral with the engine and the scavenge pump is of rotary three-lobe pattern, while the circulating water and bilge pumps are interchangeable.

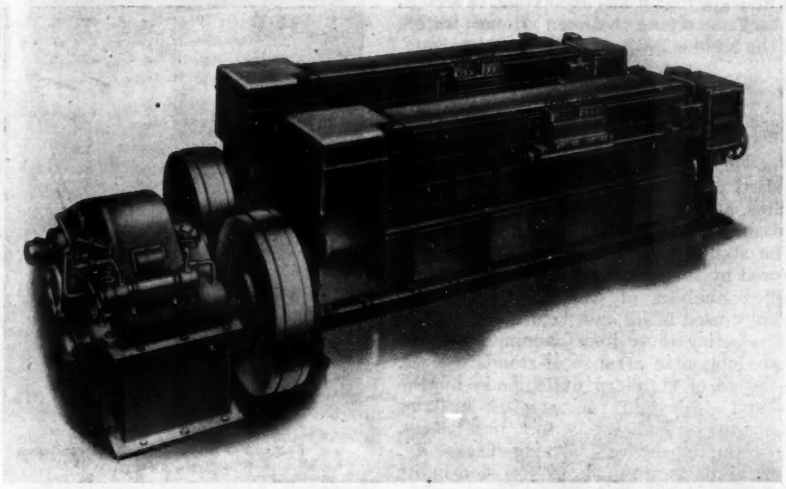


Fig. 12—3000 B.H.P. Geared Diesel Unit—Crossley

Gleniffer Engines, Ltd.

Examples from the series of diesel engines ranging from 24 b.h.p. to 120 b.h.p. which the company manufacture are displayed on the stand of Gleniffer Engines, Ltd., of Glasgow, and included are a handed pair of the 120 b.h.p. marine diesel engines of the new D.H. series. One unit is provided with electric starting and the other is shown fitted with the Gleniffer air starting motor. The engines, which are shown running under their own power, are not fastened to a base and, thus, effectively demonstrate the absence of vibration.

Our illustration Fig. 13 shows a vertical six-cylinder, four-stroke, normally-aspirated engine having a bore of 6in by a stroke of 7in, a compression ratio of 14 to 1, and developing 120 b.h.p. at 900 r.p.m. The engine has a one-piece cast iron cylinder and crankcase block bolted to a heavily ribbed bed-plate and is provided with "Meehanite" iron wet liners with rubber ring seals where the liner is a sliding fit in the water jacket. Separate cast iron cylinder heads carry one inlet and one exhaust valve horizontally opposed on opposite sides of a spherical combustion chamber, the inlet valve being held in a detachable cage.

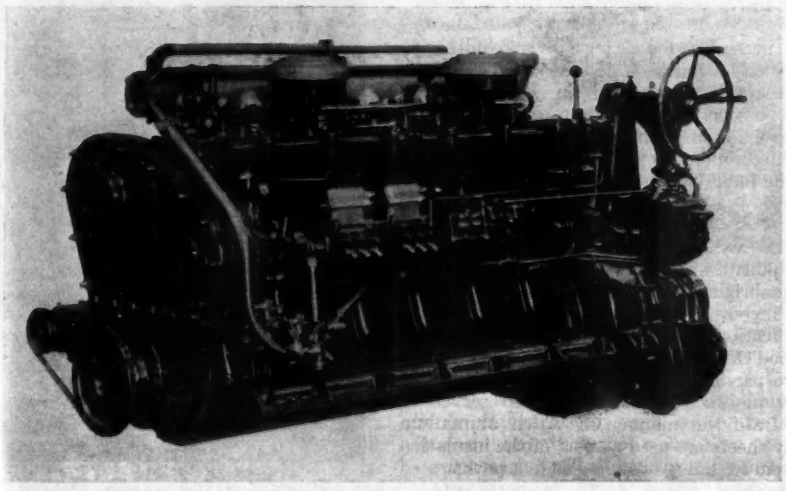


Fig. 13—120 B.H.P. Marine Diesel Engine—Gleniffer

The low expansion aluminium alloy pistons are fitted with four compression rings and one scraper ring and have a conical crown finishing in a clerestory boss which passes through the neck of the combustion chamber at top dead centre. The hollow floating gudgeon pins are pressure lubricated through drillings in the connecting-rods, which have phosphor-bronze white metal lined big-end bearings. A total of seven similar bearings carry the crankshaft, which is drilled for lubrication purposes.

The inlet and exhaust valves, which are identical and interchangeable, are actuated from a single camshaft mounted in seven plain bearings and carried in a casing at the side of the cylinder block. The vertical rockers are pivoted to the base of the camshaft casing and the exhaust valves are opened direct by a cam and rocker, while the inlet valves are pulled open by a horizontal rod. An automatically tensioned duplex roller chain drives the camshaft, fuel injection pumps and other auxiliaries, while there is a cam drive to the double-acting plunger bilge pump and an eccentric and slipper slide drive to the cooling water pump. Individual fuel pumps having their own manually controlled cut-out and priming levers deliver fuel to each cylinder through a three-hole fuel injector.

Lubricating oil is circulated at 15 lb per square inch by an oscillating plunger pump, and the circulation of cooling water, which is thermostatically controlled, is by a plunger pattern pump. For starting, three or six cylinders can be decompressed while air is admitted at 350 lb per square inch to the four-cylinder, 90-deg. vee air motor. The air bottle of 3 cubic feet capacity is charged from No. 5 cylinder, which is fitted with a charging valve and so can act as a compressor with the fuel pump cut out.

There is a bevel epicyclic reverse gear, in which the servo action of the clutches performs the actual engagement without shock, and a 2 to 1 reduction gear of herringbone design, the larger gear floating on a special hub.

Electro Methods, Ltd.

A new instrument designed to give continuous indication of feed-water contamination in ships is included in the apparatus shown by Electro Methods, Ltd., 220, The Vale, London, N.W.11. By providing the means for continuous monitoring of contamination, this instrument avoids the inherent disadvantage of the practice of carrying out analysis at intervals when the ship is in port, by which time contamination may have become excessive without being detected.

The instrument is known as the "Colimonitor" (Fig. 14), and it functions by measuring the contamination of the water by oil, in terms of the opacity of the water. A measure of the sensitivity of this system is contained in the maker's statement that less than one part per million, of oil in water, is readily detectable.

In the "Colimonitor" the opacity of the sample is compared with that of a pure distilled water sample by means of a double optical system and split photo-cells acting in opposition—a circuit arrangement which provides maximum freedom from drift.

The differential output, which is practically linear with the degree of contamination, is fed to the input of a push-pull magnetic amplifier, giving linear amplification, variable by means of a control provided. The output feeds a milliammeter mounted prominently

in the centre of the equipment panel. This meter can be suitably calibrated, giving a direct reading of amount of contamination. In series with the meter is the input winding of a second magnetic amplifier, which is loaded by an electromagnetic relay. Since the latter does not need a linear characteristic, it is designed to have a much greater stage gain. It is so adjusted that it will operate the relay when the meter is at 50 per cent of full scale. Thus the degree of contamination at which the relay operates is adjustable

FIG. 14—"COLIMONITOR" FOR CHECKING FEED WATER CONTAMINATION—ELECTRO METHODS

by means of the gain control of the first amplifier. The relay is released when the reading drops by a few per cent. The relay contacts are available for operating an alarm when the degree of contamination exceeds the predetermined value.

A single light source is used for the optical system. It provides two beams which, with the help of suitably arranged mirrors, traverse, first, a container filled with distilled water, and, secondly, a similar container fed from branch pipes from the circulating liquid under supervision.

Further mirrors converge the beams on to a split-cathode alkali-metal photo-cell.

The optical system, comprising the light source in its case, four 2½in diameter concave mirrors in holders, and liquid containers and photo-cell in a case, is mounted on a rigid flat steel plate at the top of the equipment, and is covered by an easily removable lid. The steel plate forms the roof of the lower compartment, in which are housed the magnetic amplifiers and other electrical components. On the front panel of this compartment are mounted the meter, indicating lamps, switches and input and output sockets. A pipe projects at each side for connection to the circulating liquid under supervision. The whole equipment, which is finished in grey enamel, is mounted on brackets bearing vibration mountings.

The "Colimonitor" is suitable for a 200–250V single phase, 50–60 c/s supply, and has an input resistance of about 36,000 ohms. The milliammeter is a 3½in circular scale instrument which is calibrated from 0 to 100 per cent, the full-scale deflection (5mA) corresponding to about three parts per million of oil in water. To avoid spurious indications or alarm, due to any random turbulence, the instrument is deliberately given a long time-constant of about ten seconds. Operation of the relay closes contacts which provide, at the output terminals, 6V from a built-in transformer.

The instrument was originally developed to give continuous monitoring of contamination, by oil, of the boiler feed water in tankers, and we learn that it has had extensive service on tankers plying between Home waters and the Middle East.

J. B. Purefoy Unit Tooling, Ltd.

Once again J. B. Purefoy Unit Tooling, Ltd., of Upper Tilt Works, Cobham, Surrey, is showing a representative group of its standard parts and components for jigs and fixtures, and examples of the work for which they can be used.

The standard tooling components manufactured by this firm were introduced after a detailed analysis of the individual items generally used in jig and fixture design, and then selecting those items common to most for production in a range of standard sizes. The range of standard units made by the firm and stocked in various sizes includes sections for jig bodies, adaptors, base plates, nuts, clamping devices, packing blocks, &c. All of the parts are made to precision limits and designed to eliminate, as far as is possible, the necessity for extensive machining to produce a finished jig assembly. In the photograph reproduced in Fig. 15 there can be seen a typical group of jigs and fixtures made up from standard parts, with two of the components which have to be machined in the foreground.

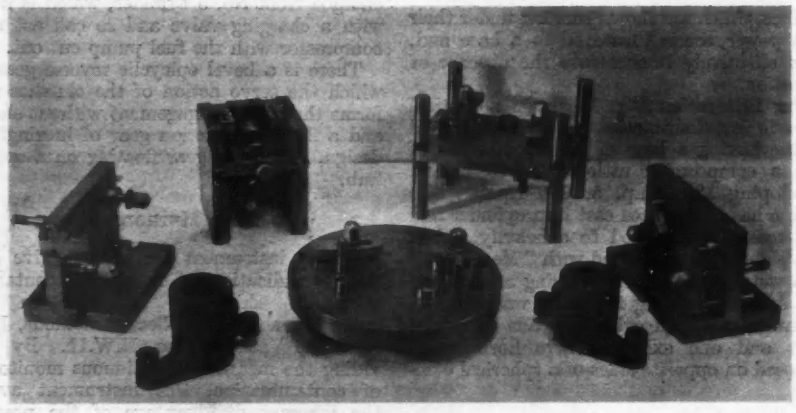


FIG. 15—STANDARD TESTING UNITS—PUREFOY

Birmabright, Ltd.

The various items of aluminium alloy equipment which are shown on the stand of Birmabright, Ltd., of Birmingham, depict the increasing use of the alloys for marine applications. The construction of the stand embodies certain production ideas which have particular reference to the carriage of food and a composite mock-up serves to illustrate the manner in which aluminium alloy sheets are used as part of the insulation system for lining of the holds in a refrigerated cargo ship.

Another section of the mock-up represents a typical arrangement of a trawler's fish hold as designed in aluminium alloy, which exploits the hygienic qualities of the material. Stanchions which are extrusions of double hollow cruciform section, with flanges about ⅜in thick, are set up and fixed in position by deck and deck-head spigots, and a typical arrangement of hold stanchions on board a trawler is shown in Fig. 16. There are

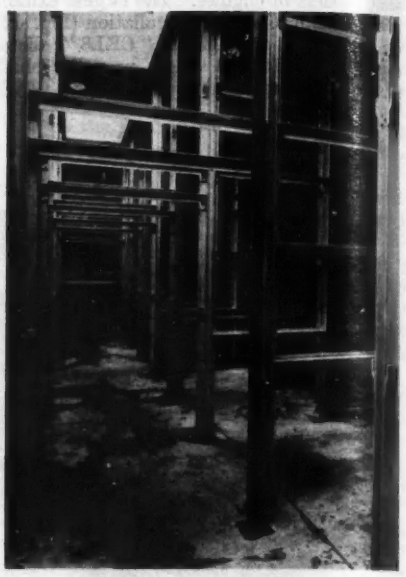


FIG. 16—FISH-HOLD STANCHIONS —BIRMABRIGHT

examples of extruded pound boards, shelving, and divisions, two designs being on view, namely, one of corrugated form and latest pattern which is a hollow extrusion fitted with end plugs to enable it to float. A wing bulkhead is included and shows the method of construction advocated for light metal. For the floor of the stand, plates embodying the new "Hobnail" pattern tread are used, the design being arranged so as to provide a sure grip.

An example of a recent development in

FIG. 17—ALUMINIUM ALLOY DAVIT —BIRMABRIGHT

light alloy application is exhibited, and there is an arm of a "Crescent" lifeboat davit which has been built by Welin-Maclachlan Davits, Ltd., and is illustrated in Fig. 17. In the construction of the box section two channel sections are used in association with ⅛in thick cheek plates, the whole being welded by the Argon arc process. The material employed is to standard specification N.6, which is a non-heat-treatable 5 per cent aluminium magnesium alloy. The arm shown is designed to form part of a set to carry a 28ft lifeboat, the working load being 5 tons per set and the test load 11 tons, the construction adopted giving a weight saving of 52 per cent over its steel counterpart. The exhibit, along with several other pairs of davits, are to be installed on board Portuguese liners now being built in Belgium.

GEORGE COHEN, SONS AND CO., LTD.

As in previous years, there is a useful range of sheet metal working plant to be seen upon the stand occupied by George Cohen, Sons and Co., Ltd., of Sunbeam Road, London, N.W.10. Most of these machines are now generally well known, but one that has not previously been illustrated in these columns is the combined punching, shearing, cropping, and notching unit shown in Fig. 29. This machine is built up of heavy welded plates reinforced with 2½in thick spacer plates.

The machine is driven by a 5 h.p. motor through vee belts and the punching and shearing ends are separately controlled through a clutch. Mild steel plate up to ½in thick can be sheared in the machine and the punching capacity is from ⅜in through

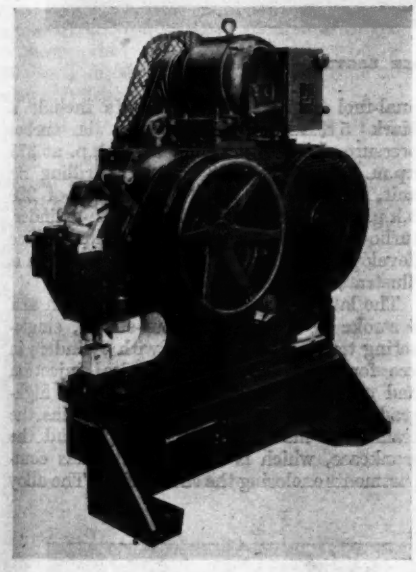


FIG. 18—COMBINED PUNCHING, SHEARING, CROPPING AND NOTCHING MACHINE—COHEN

⅝in plate to 2in through $^{7}/_{32}$in plate. The punch unit throat is 10in deep and, by means of a handwheel at the side of the machine, the punch can be brought down on to a marked position to ensure accurate punching of the hole. The cropping unit handles angle or tee 3in by 3in by ⅝in square or 2⅝in by 2⅝in at 45 deg.; round bars up to 1½in or square bars up to 1in can also be cropped. The notching capacity is up to 2in by 2in square or vee.

Light-gauge and medium-gauge "Weybridge" gang slitting machines are shown. The light-gauge model for 22 S.W.G., 30in wide mild steel has adequate capacity for most tinplate sizes used in the metal box and can-making industries. When the machine is required to produce rectangular blanks a hand-operated cross-cutting attachment can be fitted to the feed table.

Medium-gauge slitting machines of 36in and 48in cut up to 8 S.W.G. mild steel. They can be used with independently driven coiling gear.

The associated company, K. & L. Steelfounders and Engineers, Ltd., of Letchworth, Herts, is displaying upon its stand one of the new "Jones KL 66" mobile cranes fitted with a 60ft lattice jib. This crane, which was described in our issue of March 2, 1951, has a rated maximum load of 6 tons at 9ft radius. The maximum load can be hoisted at speeds up to 40ft per minute and lighter loads up to 2 tons at 120ft. per minute. A differential which is used in conjunction with the four-wheel drive of the machine eliminates wheel spin and gives good tractive power.

BRITISH TWIN DISC AND CLARIFIERS, LTD.

British Twin Disc and Clarifiers, Ltd., of London, is showing on its stand an example (Fig. 19) of the twin disc marine gears manufactured in Great Britain under licence. Present production models have a reduction

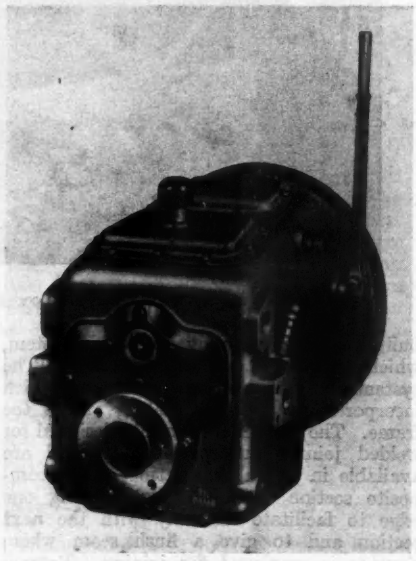


FIG. 19—MARINE GEAR—BRITISH TWIN DISC

ratio of 1·96 : 1 and are suitable for powers ranging from 105 h.p. to 175 h.p.

The case, which is of high strength cast iron, has heavy-section bearing supports and is strong enough to maintain alignment under all load conditions. Heat-treated and ground alloy steel shafts of large diameter are used and anti-friction bearings are fitted and located by snap rings, which simplify manufacture. The gears are wide faced, have hardened and ground helical teeth. In the gear train two gears provide the reduction in the forward direction and three are employed in the reverse reduction, full forward speed being available in reverse. In the heavy-duty duplex clutch, bi-metallic friction discs bear against ground cast iron alloy plates and wear is automatically taken up by a spring-loaded construction.

Lubrication is by the splash system, the oil supply being independent of the engine lubricating system, and the oil is maintained at a moderate temperature by a built-in cooling jacket. The propeller shaft coupling flange is fabricated from a dropped steel forging, and there is a built-in propeller thrust bearing of ball bearing construction.

Operation is by a single lever which actuates a sliding sleeve to move a floating plate into contact with the ahead or astern driving plates. By providing full speed forward and in reverse, the gear, which is approved by Lloyd's, makes it unnecessary to fit handed engines when twin screws are adopted.

SENTINEL (SHREWSBURY), LTD.

Among the oil engines exhibited by Sentinel (Shrewsbury), Ltd., of Shrewsbury, is a new model which is being shown for the first time, (Fig. 20). It is a vertical, two-cylinder, direct-injection engine fitted with clutch and pulley for industrial purposes. The engine, which has a bore and stroke of 4¾in and 5½in respectively, has a compression ratio of 16·5 to 1 and a rated output of 30 b.h.p. at 1500 r.p.m.

A rigid one-piece casting forms the cylinder block, which is bolted to the crankcase and is fitted with renewable wet liners of loaded centricast iron, having two rubber sealing rings at the bottom. The cylinder head, which is of high-quality cast iron, has ample water spaces and includes large size heat-resisting steel inlet and exhaust valves, having stellited tips. Aluminium alloy high-speed pattern pistons, having toroidal cavities in the crowns, are fitted, and each is complete with three compression rings above and one slotted scraper ring below the fully floating gudgeon, which is retained by circlips. The two top compression rings are chromium-plated.

Nickel-chrome steel stampings is used for the connecting-rod which has a phosphor-bronze bush at the small end and a steel-backed lead-bronze bearing at the big end. The big

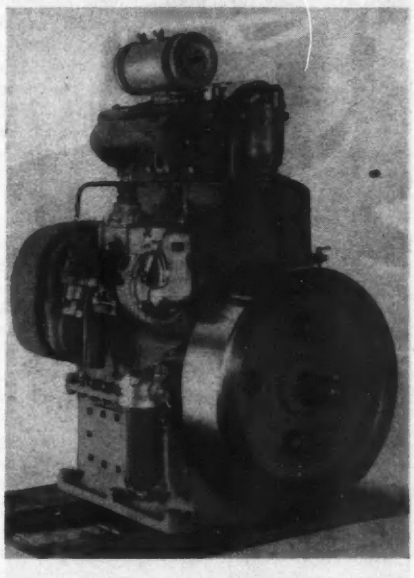


FIG. 20—TWO CYLINDER INDUSTRIAL ENGINE—SENTINEL

end bearings are pressure lubricated through drillings in the crankshaft, which is of 55–65 tons per square inch heat-treated, forged alloy steel, has integral balance weights, and is carried in three steel-backed white metal lined pressure lubricated bearings.

Operation of the valve gear is from a hardened and ground steel camshaft through cam followers having chill-cast bases, push rods and pressure lubricated rocker arms. Valve clearances are adjusted by a tappet screw. A standard fuel pump with integral centrifugal governor supplies fuel through a multi-hole injector to the combustion chamber, which is designed to give efficient combustion and clean running. The engine is lubricated by a gear pump driven

from the crankshaft, which draws oil from the lower crank case through a strainer and then feeds it through a filter and, by way of drilled passages in the cylinder block, to the main bearings, camshaft and valve gear. A centrifugal pump, having a cast iron body and impeller and driven by gears from the timing case, circulates the cooling water. The gears in the train are made from specially heat-treated steel, while the crankshaft pinion is of case-hardened nickel-chrome steel.

The engine has an overall height of 41¼in, a maximum width of 24 5/16in, a shaft length of 44in, and a dry weight of 1070 lb.

Metalock (Great Britain), Ltd.

Examples of the work done and the equipment used for its system of repairing fractures in heavy castings, forgings, &c., are displayed upon the stand of Metalock (Great Britain), Ltd., Grand Buildings, Trafalgar Square, London, W.C.2. This system of repair, which is now being extensively used for cold repair work *in situ*, consists basically of driving a number of specially shaped key elements into the work, transversely across the crack in the damaged part. The key elements are then sealed and locked in position by cold working to hold the parts rigidly together. The system was described in detail in our issue of October 24, 1947.

As a matter of interest we reproduce on this page a photograph (Fig. 21) of a repair job completed a short while ago by the company at the Surrey Commercial Docks. When the docks were examined a fracture some 4ft 7in long was found in the casting of the superstructure used to hold a gate in place. These gates were being changed for the first time in twenty years, and each one weighed about 170 tons. On one face of the casting the repair had to be effected in the shortest possible time, as it could only be exposed between the removal of the old gate and its replacement by a new gate. Two Metalock operators working on a raft repaired the crack, which was about 1ft long, in four hours, at the end of which the gate was placed in position ready for operation.

Fig. 21—Metalock Repair Job—Metalock

T.I. Aluminium, Ltd.

On the stand of T.I. Aluminium, Ltd., of Birmingham, is displayed a range of the company's products in light alloy, which are used for marine applications and in general engineering, and which comply with Lloyd's Rules and the regulations of other appropriate bodies.

The main exhibit is a section of a barge, built in aluminium alloy, on a new system, which is named "composite plating." The system employs a special extrusion, which incorporates a strip of plating and a toe frame. The section is primarily designed for welded joints, but special extrusions are available in which the plating of the composite section is down joggled along one edge to facilitate assembly with the next section and to give a flush seam where riveting is employed for joining. Bottom and side plating panels and bulkheads are fabricated by welding lengths of the composite section together by the Argon arc process. The new method of construction is being used to build a series of barges intended for use on the inland waterways of the Congo; they have a length of 77ft, a beam of 11ft 6in, a depth of 4ft 6in, and carry 60 tons of cargo in two holds each 30ft long. In Fig. 22 is shown a completed section of a barge, built by Thorpe Brothers (Bessborough) Works, Ltd., Molesey, which illustrates the use of the new extrusion in constructing this form of river craft.

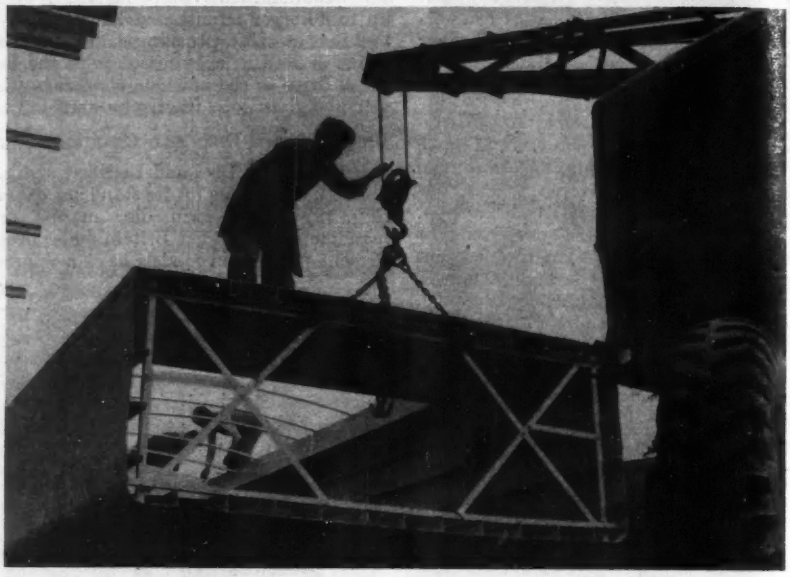


Fig. 22—Aluminium Alloy Barge Section—T. I. Aluminium

English Electric Company, Ltd.

The English Electric Company, Ltd., of Rugby, exhibit a number of the engines manufactured by the company for marine, rail traction and for oil field duties, including dual-fuel engines. The exhibits include a Mark 5 S.R.L. engine, which is turbo-pressure charged, develops 938 b.h.p. at 375 r.p.m., and weighs 38 tons; a drilling rig unit, powered by an "H" engine of 220 b.h.p. at 1500 r.p.m.; and a sixteen-cylinder, turbo-pressure charged rail traction engine developing 2000 b.h.p. at 850 r.p.m., which is illustrated in Fig. 23.

The latter engine, with a bore of 10in and a stroke of 12in, is of four-stroke, single-acting trunk piston design, with cylinders in vee form and having mechanical injection and exhaust gas turbo-blowers. The high-grade alloy cast iron bed-plate contains the crankshaft main bearing housings, and the crankcase, which is in two parts, has compartments enclosing the camshafts. The alloy

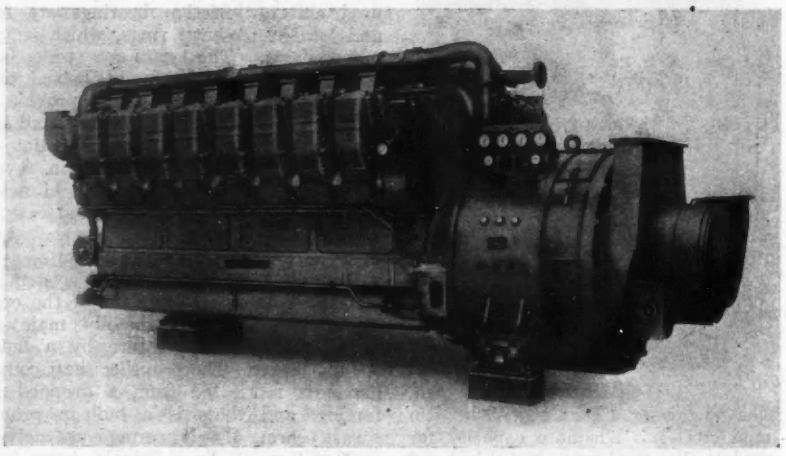


Fig. 23—2000 B.H.P. Rail Traction Engine—English Electric

cast iron wet cylinder liners have specially finished bores, are held in position by the cylinder heads and can expand downwards. Each cylinder has a separate cast iron cylinder head having a combustion chamber roof and including valves and a water-cooled fuel injector sleeve, the cooling water being led through external pipes from the crankcase. Aluminium alloy pistons, with a bowl-shaped combustion chamber in the crown, are fitted and have four pressure and two slotted oil control rings, the top pressure ring being chromium-plated. Steel circlips retain the fully floating case-hardened alloy steel gudgeon pins. The connecting-rods are heat-treated alloy steel drop forgings, the big-end bearings consisting of steel shells lined with copper-lead and the small-end being a phosphor-bronze bush, pressure lubricated. The heat-treated, high-grade alloy steel crankshaft is drilled for lubrication purposes, and is carried in copper-lead steel-backed bearings.

Two nickel steel inlet and two silicon-chrome exhaust valves with stellited stems are fitted, and they seat inserts of Endurm iron. Operation is by "H" section drop-forged levers, push-rods and hardened rollers from cams on camshafts which are driven by a triple roller chain through intermediate shafts and spur gears. Separate fuel pumps are fitted to each cylinder and there is a mechanical governor with hydraulic servo-gear. An engine-driven pump lifts the lubricating oil from the sump to a gravity tank and a second engine-driven pump delivers the oil to the high-pressure lubricating system, while a reducing valve provides low-pressure oil for lubrication of the valve gear. Cooling water is circulated by two engine-driven centrifugal pumps arranged to keep the water temperature below 190 deg. Fah. and that of the lubricating oil below 150 deg. Fah.

Coventry Victor Motor Company, Ltd.

The Coventry Victor Motor Company, Ltd., of Coventry, displays a representative range of its air-cooled and water-cooled diesel and petrol engines, pumping and generating sets, including two new engines. They are a water-cooled diesel engine, Mark W.D.3, of 9/11 h.p., and a horizontally opposed, four-cylinder, air-cooled petrol engine, the "Neptune."

The W.D.3 engine (Fig. 25) has a bore of 90mm by a stroke of 100mm, and is rated to develop 9/11 h.p. at 1500 r.p.m. It is provided with a special aluminium alloy crankcase and an easily detachable cylinder of high-tensile cast iron having a bore highly finished by a special process. A cylinder head of high-quality close-grain cylinder iron is fitted and incorporates renewable valve guides. The aluminium alloy piston has three compression and one scraper ring, and a high-tensile steel, fully floating gudgeon pin, hardened, ground and lapped, and retained in position by circlips. Forged from high-tensile steel, the connecting-rod has the big-end lined with white metal and there is a bronze bush at the small-end. The crankshaft is made from a high-tensile steel forging specially heat-treated and carefully balanced, and carried in bearings of bronze lined with white metal. It is drilled for pressure feed lubrication to the bearings.

The special steel overhead valves are actuated by rockers, having double return springs, and push rods operated by a solid steel, hardened and ground camshaft driven by a duplex chain from the crankshaft.

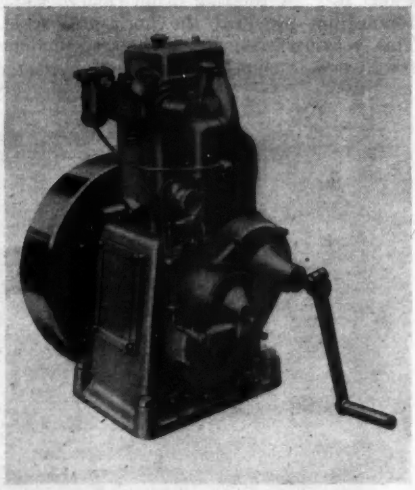


Fig. 25—Water Cooled Diesel Engine—Coventry Victor

A standard injection pump supplies fuel to an enclosed pintle spray nozzle, and the speed is controlled by a mechanical governor. Lubricating oil is delivered under pressure to the bearings by a gear-pattern oil pump driven from the crankshaft and a pressure release valve returns surplus oil to the sump. The engine, which is shown fitted with an 8in vee groove pulley fitted to the flywheel, weighs approximately 296 lb.

The four-cylinder, four-stroke "Neptune" air-cooled petrol engine shown in Fig. 24, has a bore and stroke of 80mm and a power range of 12 h.p. to 26 b.h.p. Aluminium alloy is used for the crankcase, while the cylinders are of monobloc design cast in high-tensile, close-grain cylinder iron, the bores having a special finish to give long life. Detachable cylinder heads of heat-treated, low-expansion aluminium alloy are fitted and the pistons, which are of the same material, have two compression rings and one scraper ring. The specially designed connecting-rods are of 3 per cent nickel steel, drop forged, and have detachable big-ends with steel-backed shell bearings.

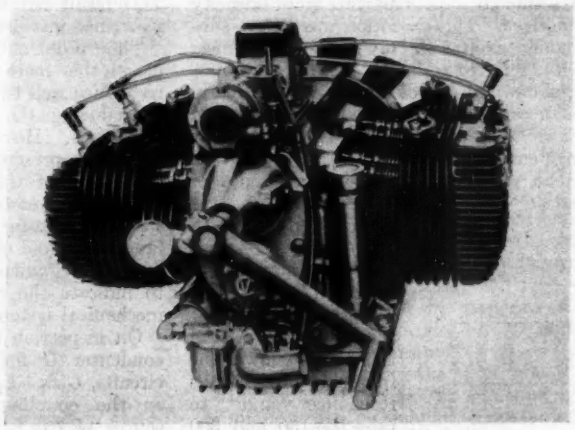


Fig. 24—Horizontally Opposed Petrol Engine—Coventry Victor

A duplex silent chain drives the solid steel, drop-forged heat-treated crankshaft, which is accurately ground and runs on three steel-backed detachable shell bearings, provision being made for thrust loads. There are solid balance weights to each throw and the crankshaft is drilled for feeding lubricating oil under pressure to the bearings. High-tensile, non-corrosive steel is used for the valves, which are directly operated by tappets actuated by cams on a solid steel hardened and ground camshaft, mounted over the crankshaft, and driven by a silent duplex chain.

Ignition is by an impulse starting magneto, and a gear pump supplies lubricating oil under pressure to all bearings, other parts being splash lubricated. The engine is effectively cooled by air delivered by a flywheel fan over the finned cylinder barrels and heads. The overall width of the engine is 25in, the length 35in and the height 19¾in, while the weight is approximately 350 lb.

British Ropes, Ltd.

A sample length of what is thought to be the biggest wire rope sling yet made in this country is exhibited by British Ropes, Ltd., of Doncaster. This sling will be used on an oil refinery at Grangemouth. It consists of eight wire ropes, each 3in circumference of special plough steel, made on the "Blue Strand" preformed principle and braided together to give a sling with an actual breaking load of 56 tons.

This firm is also making a special display of its "Paraflex" equal lay steel wire rope for cranes. Hitherto its 6×37 construction steel wire rope has been supplied with the strands made up of eighteen wires over 12 over 6 over 1 each lay of wires having a different length. Instead of this 6×37 rope the company now supplies the "Paraflex" with six strands, each of thirty-seven wires, the strands being made up of fourteen wires, over 7 and 7 over 1, each layer of wires having the same length of lay.

In the usual construction of 6×37 rope successive layers of wires are laid to a longer length than the under layers. Each wire, therefore, crosses over the crowns of the underlying wires with resultant deterioration due to local crushing and cross cutting. In the "Paraflex" 6×36 equal lay construction, all layers of wires have the same pitch or length of lay. Each wire in each layer therefore lies in a bed formed by the interstices or valleys between the wires in an under layer, or else it lies along the crown of an underlying wire. It is claimed that, in this new form of construction, the degree of flexibility is practically the same and the very small difference is more than compensated for by the increased resistance to wear, greater efficiency and elimination of cross cutting and secondary bending.

This firm is also showing examples of nylon ropes and cloth, special shaped and pinion wire, silver steel and bright bars, wire drawing dies, &c.

(To be continued)

Services' Standard for Proof Stress Testing.—A new specification governing the determination of proof stress of metallic materials, where this is called for in Government contracts, has been published by the Ministry of Defence. It is one of a new series of general specifications for Inter-Services equipment drawn up by the Ministry's Engineering Standards Co-ordinating Committee. Seven methods of testing are listed in the specification for use in Government orders unless individual notice is given that one or more of them are unsuitable. The specification also lays down the degree of accuracy which testing equipment should attain. Copies of the specification (DEF 2—Proof Stress Testing) are obtainable from H.M. Stationery Office, price 1s.

An Experimental Method of Vibration Analysis

By R. YORKE and K. R. McLACHLAN

THE work described in this article is part of a wider programme of research in the Engineering Department, University College, Southampton, into the characteristics of sound reproducing apparatus, with special reference to reproduction from gramophone disc recordings. Ideally the output from the pick-up in such a system would be a faithful electrical copy of the groove modulation. Deviations

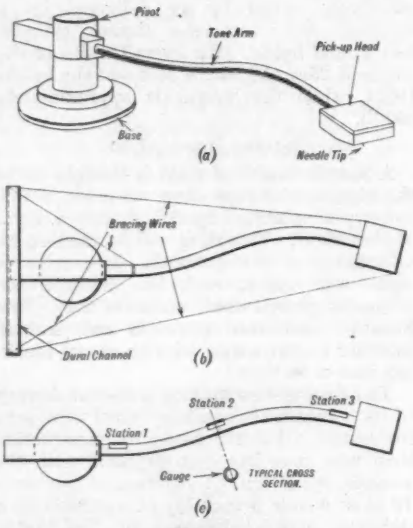


FIG. 1

from this ideal were noticed in many cases could which not be traced to any electrical imperfections. These irregularities were found to be due to mechanical vibrations of the tone arm and resonance of the needle, and methods were developed for analysing and eliminating them.

The typical technique involved in making these tests is described in detail for one particular pick-up, a sketch of which is shown in Fig. 1 (*a*). Graphs showing the variations in electrical output over a given frequency range were displayed on the screen of a cathode ray oscillograph and photographically recorded. Resistance wire strain gauges were applied to the tone arm and their electrical response similarly recorded. These graphs were used to determine the frequency and approximate magnitude of the mechanical vibrations. Later, graphs were plotted to indicate the effectiveness of certain mechanical adjustments. To simplify this problem an analogy was drawn between the mechanical system and an equivalent electric circuit.

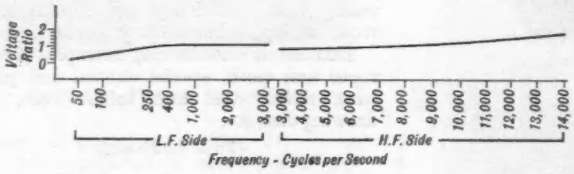


FIG. 2

To generate the vibrations a gramophone record having sinusoidal modulation was used, the characteristics of which are shown in Fig. 2. The voltage to be indicated was fed via an amplifier to the vertical deflection plates of the cathode ray tube. When connected to the pick-up the amplifier gain required was about 500, and when indicating the strain gauge voltages the value was about 10^6. A rotating drum camera using 16mm film provided the horizontal scale. This rotating drum and the gramophone record were synchronously interlocked, thereby providing the required fixed relationship between time and frequency at the camera.

The pick-up used for these experiments was a hand-made unit of good design, but as Fig. 3 oscillogram (*a*) shows, the electrical characteristic was far from ideal. The h.f. part of the characteristic appeared reasonable, although some departure from linearity was noticed. This deviation was due to subharmonic excitation of needle resonance, which is referred to later. The l.f. characteristic shows the effect of violent tone arm resonances at approximately 50, 150 and 300 c/s. They are indicated as typical phase change curves.

In an effort to determine the modes of vibration the following experiments were made :—

(1) A mass of considerable moment of inertia (7·6cm cube, 2·3kg) was added at the pivot. The effect of this was to lower the frequency of the 50 c/s resonance and to raise the 150 and 300 c/s resonances, but the changes were small. This experiment indicated that the lowest was pivotal resonance and the two higher lateral or torsional resonance in the arm.

(2) The next step was to decide whether the higher resonances were due to lateral or torsional vibration. This was done by resting on the pick-up head a mass whose length was great compared with its breadth and width (9cm by 0·6cm by 0·2cm, mass 20g). It was arranged in such a way that the particular vibration which was to be damped had to accelerate the whole mass along its major axis. The result of this test showed that the major resonances were lateral, although some minor effects were due to torsional vibration.

(3) It was felt that lateral stiffening of the arm would separate the lateral resonances from others by raising their frequency. Bracing, as shown in Fig. 1 (*b*), was fitted and had the effect of increasing the lateral stiffness considerably whilst producing little effect on the torsional strength. This system of bracing altered to some extent the frequency of the higher lateral modes of vibration, but produced no measurable difference in the lower pivotal resonance.

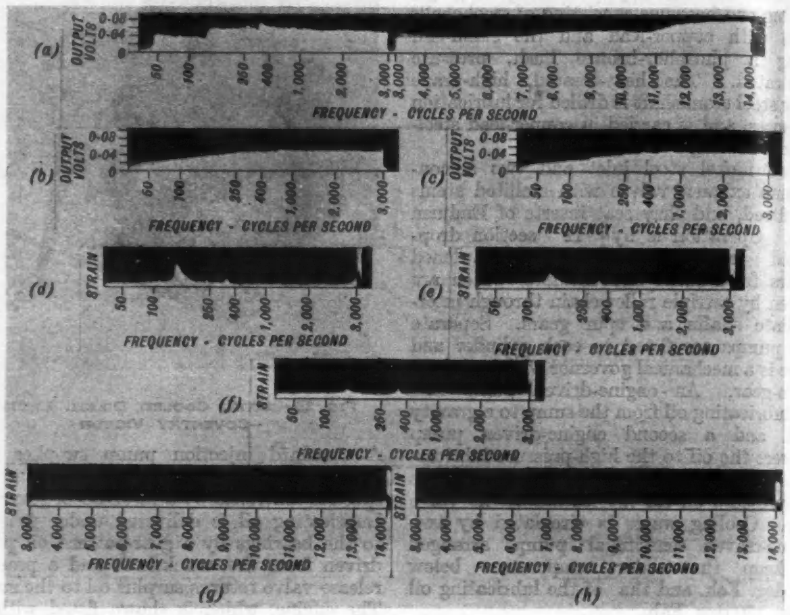


FIG. 3

(4) With the bracing still in place the large mass was again added at the pivot. Again the lowest resonance was lowered, but the higher modes of vibration were unaffected. This result left little doubt that the lower resonance was pivotal.

The problem, therefore, was to find a practicable method of lowering the pivotal resonance well below the recorded range and of reducing the amplitude of the lateral vibrations. However, where several resonances are present in a mechanical system, separation of the component vibrations is difficult. Therefore it was decided at this stage to transfer the problem to the more familiar ground of electric circuits. Accordingly the circuit shown in Fig. 5 was drawn to indicate the electrical equivalent of the mechanical system.

On inspection this circuit shows that the condenser C forms part of two resonant circuits, $C(L_1+L_2)$ and (CL). It also serves as the coupling impedance between the source of e.m.f. E and the other resonant circuits (L_1C_1) and (L_2C_2). In considering this circuit it must be remembered that the relative values of the elements are such that $C(L_1+L_2)$ resonate at the pivotal resonant frequency, (L_1C_1) and (L_2C_2) at the two arm resonant frequencies and (LC) at the needle resonance. For simplicity resistive losses have been ignored. As stated, C forms the coupling impedance to the arm resonant circuits and therefore alteration of its value changes the excitation e.m.f. at these circuits. Another important result of such a

change is the alteration of the pivotal resonant frequency.

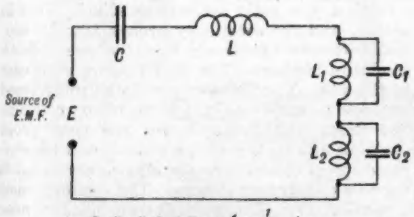
The solution to the problem then appeared to be to effect an increase of the needle support compliance. Fortunately, in this particular pick-up it was easily accomplished and the following experiments were made to determine the effectiveness of the method.

(1) The needle compliance was increased.

(2) With the bracing still in place, a characteristic curve was taken. It is reproduced in oscillogram (*b*), Fig. 3, which shows that all major resonances have been eliminated.

(3) In order that the full effect of change in needle compliance might be seen, the bracing was removed and another characteristic curve taken. Oscillogram (*c*) shows clearly that this did not bring the pivotal resonance near the recorded range and that the 150 and 300 c/s resonances reappeared but at a very much reduced amplitude.

It was felt that a more detailed analysis of the mechanical vibrations using resistance



C = Needle Compliance ($= \frac{1}{\text{Stiffness}}$)
C_1 & C_2 = Tone Arm Compliance.
L = Needle Mass.
L_1 & L_2 = Tone Arm Mass.

FIG. 5

wire strain gauges should be made. Accordingly strain gauges were applied, as shown in Fig. 1 (*c*) and their outputs were fed singly through the high gain amplifier to the oscillograph. Considerable trouble was experienced with hum and other undesired noise, so that, in interpreting the strain gauge records, the level at 2000 c/s should be taken as zero reference level of strain. Oscillogram (*d*) shows the amplitude of vibrations plotted against frequency at Station 1 in the range 10 to 3000 c/s, indicating the two principal frequencies at which lateral vibration occurs.

Oscillogram (*e*) shows the amplitude of vibration at Station 2 over the same range. Oscillogram (*f*) similarly shows the amplitude of vibration at Station 3. From (*d*), (*e*) and (*f*) it is apparent that the two major modes of vibration are due to lateral bending and line up with the phase change curves at 130 and 290 c/s in the electrical characteristic. The resonance at approximately 1000 c/s, which shows only in oscillograms (*e*) and (*f*), is probably due to torsional vibration. Helical distortion of the gauge would allow this vibration to be indicated.

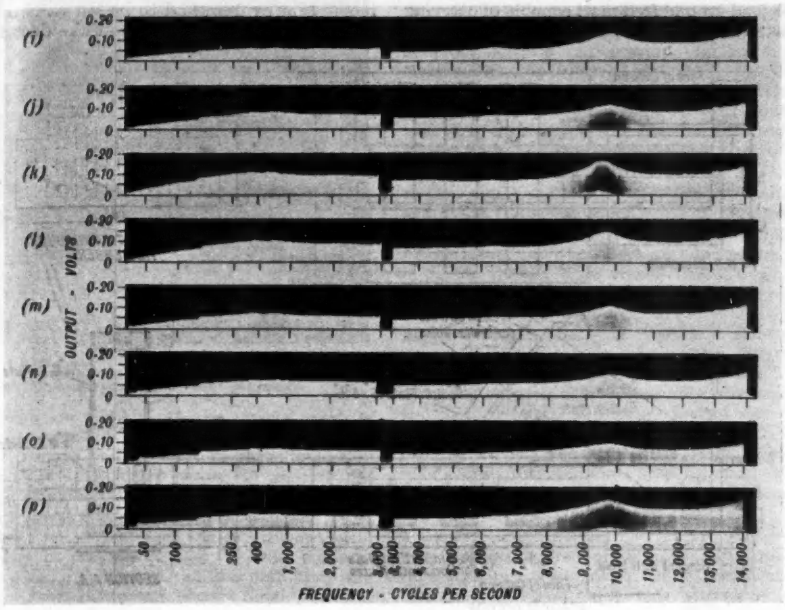


FIG. 4

Two records were taken to find whether any appreciable mechanical vibration existed in the range 3 to 14 kc/s. They are shown in oscillograms (*g*) and (*h*) and, as expected, there were no measurable vibrations. An electrical characteristic curve was then taken. It is shown in oscillogram (*i*), Fig. 4, indicating the electrical response for the mechanical conditions obtaining in oscillograms (*d*) to (*h*), inclusive. Two peaks can be seen in the characteristic at approximately 6·3 and 9·7 kc/s. It was noticed when the waveform was displayed on the oscillograph that considerable second harmonic distortion existed at 9·7 kc/s and third harmonic distortion existed at 6·3 kc/s. This fact indicated that a resonance existed in the neighbourhood of 19 kc/s and that the two peaks in the characteristic were due to sub-harmonic excitation of this resonance.

It was determined by experiment that the needle resonance was at 19 kc/s and would therefore account for these phenomena. A reduction in the amplitude of these peaks could be effected by (i) reducing to a minimum the harmonic content of the needle excitation and (ii) by damping the needle resonance. The harmonic content of the needle excitation was due to the worn state of the needle and experience with other units proved that this distortion would be very much reduced on fitting a new needle.

By virtue of the close coupling between the mechanical circuit of the needle and the electrical circuit, the needle resonance could be damped by loading the electrical output. Two ways were considered by which this loading could be effected—resistively, which would present a constant load to the pick-up, and by tuned circuit, which could be arranged to provide maximum loading at the needle resonant frequency. It was felt that resistive loading would be adequate and oscillogram (*j*) shows the characteristic when suitably loaded. Comparison of (*i*) and (*j*), Fig. 4, clearly shows the damping effect of resistive loading on the undesirable sub-harmonic resonances.

Preliminary experiments showed that the needle support compliance had considerable effect on the arm resonances. It was felt, therefore, that some measurements should be made of electrical response for various values of needle compliance. These results, (*k*) to (*o*), inclusive, show clearly that as the needle compliance was reduced the arm resonances became more pronounced and pivotal resonance was brought within the recorded range. At the same time a lessening of sub-harmonic distortion was noticeable. Oscillogram (*p*) was taken with the electrical load removed, but otherwise under the same conditions as (*o*), and the difference again shows the effect of resistive loading, discussed above in connection with oscillograms (*i*) and (*j*).

It appears that the conditions obtaining in oscillogram (*m*) offer the best compromise.

Conclusions

These experiments enabled the type and frequency of vibration in the mechanical system to be determined. They showed that adjustments of a purely mechanical nature had considerable effect on the electrical system and conversely electrical loading produced damping of the mechanical resonances.

Although this article describes work done on a small mechanical vibrating system, there is no reason why a similar technique should not be applied to larger vibrating structures.

The S.B.A.C. Twelfth Exhibition

The outstanding annual event of the aeronautical calendar, the Society of British Aircraft Constructors' (S.B.A.C.) Flying Display and Exhibition, is to be held next week at the airfield of the Royal Aeronautical Establishment, Farnborough, Hants. It will be the twelfth display and the fourth to be held at Farnborough. The programme, as before, is to run for six days starting on Tuesday, September 11th, and concluding on Sunday, September 16th. Of these days the public are to be admitted on Saturday and Sunday only, admittance during the first four days being confined to S.B.A.C. guests, technicians and the Press. Details of the daily flying programmes so far released indicate that the display will be as impressive as before. The more outstanding demonstrations are expected to be those of the "Valiant" and "SA/F" four-engined jet bombers, which have recently made their first flights, and the new production versions of the Vickers and Hawker interceptor aircraft. The "delta" wing aircraft, although exhibited before, will also give their first public demonstrations. These machines will be amongst about twenty aircraft to make their debut at Farnborough. The latest versions of numerous other civil and military machines are included in the display, whilst the "Brabazon," amongst others, will be available for inspection in the static park. It is expected also that two flying test beds will attend, one flying with a Napier "Nomad" compound engine, and the other a "Canberra" fitted with two Armstrong Siddeley "Sapphire" engines. Many other engines will be displayed in the exhibition along with an extensive array of aeronautical equipment.

An Unusual Factory Structure at Bristol

A FACTORY for the processing of cellophane, the design of which presented several unusual problems for the structural engineer, has recently been under construction for Colodense, Ltd., at Malago, Bristol, and the first part of the factory has been completed and is now in use for production. The very specific requirements for the structure were met by the extensive use of both precast and prestressed concrete, the use of which was largely dictated by the shortage of steel and timber. However, the resulting structure is not merely a substitute and compares economically with more traditional buildings so that it would probably have been the right solution to the particular problems, even in the absence of any shortages.

The final building is to consist of five production floors, each 300ft by 100ft. Because it is necessary to keep the temperature and humidity constant in each floor, but possibly different in different floors, a special system of air conditioning (extract and intake) had to be accommodated for each floor. For this purpose an extra service floor became necessary for each production floor. The separation between a production floor and its service floor had to be such that the ceiling over the production floor was completely flat, the service floor was to be readily removable, and the minimum amount of space was to be lost for this construction. At the same time, the separation between the production floors and the service floors had to be fireproof so that a conflagration in one production floor would not affect the storeys above or below.

It was important to have as few columns as possible inside the production floors and a grid of 33ft 4in by 30ft was selected. To allow for possible changes in use, the production floors were calculated for a live load of 4 cwt per square foot, and the service floors were calculated for a live load of 100 lb per square foot.

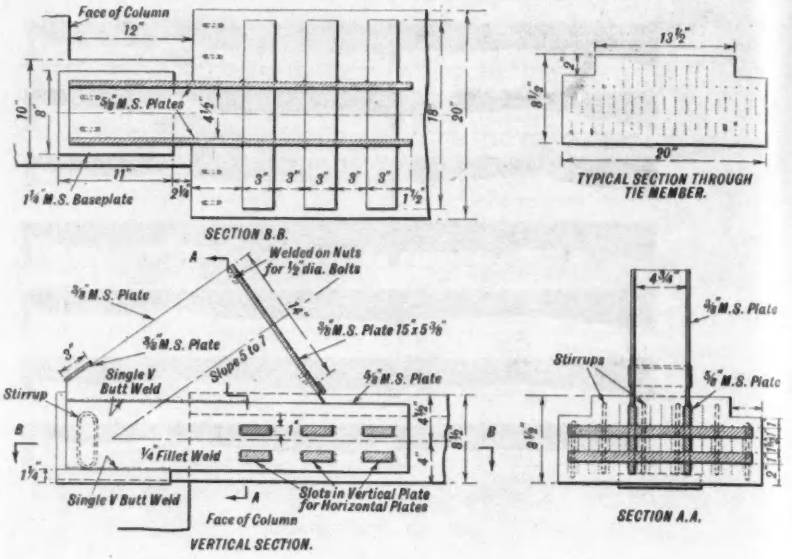
The final building height from ground floor level to roof level was not to exceed 107ft, and as the clear height required for each production floor was 13ft 3in and the service floors, at least at certain points not less than 7ft, there was very little space left for construction depth. An annexe, 80ft by 80ft, was required to house offices, ventilation plant, and various accessory processes. This annexe was to have twice as many storeys as the main production building, i.e., ten storeys, within the same total height, each alternate storey coinciding with the level of a production floor. A column grid of 20ft by 26ft 4in was adopted to fit in the ventilation plant, so that here again there was very little depth available for the construction.

Originally, no basement was required apart from a boiler-house, but preliminary investigation of the site showed that the ground conditions were extremely bad. In fact, part of the site had been a clay pit at one time, and while good ground (red marl capable of carrying 5 tons per square foot) could be found at one point under the production area at a depth of only 3ft, it dropped to a general level of about 40ft to 45ft under the annexe, and in places even to 62ft. Calculations indicated that a basement could be provided with very little extra cost, and as storage space was extremely scarce, a basement varying in depth from 11ft to 17ft 6in was arranged under the production area and down to 35ft under the annexe.

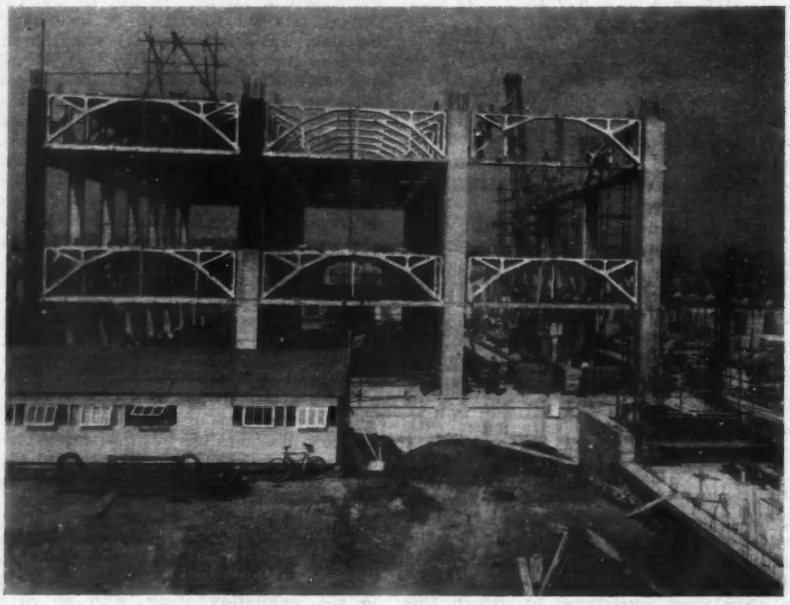
Construction of the building was planned in stages, owing to licensing difficulties. The first stage comprised two production floors, each with its service floor, over part of the total production area, and four storeys of the annexe over its total area, together with the basements. This stage has now been completed and will be described in greater detail; it is shown under construction in the accompanying illustration. The second stage, comprising the two production floors over the remainder of the area, has just been started.

It will be seen that, for the production area, a system of main and secondary trusses was adopted, spanning 33ft 4in and 30ft respectively, the shape of which was dictated by the need to accommodate the air-conditioning ducts. The columns are 3ft by 4ft in plan, but a recess 12in by 16in had to be left at two sides of each column to allow the intake duct to go down from the service floor into the production floor without taking additional space. As these ducts are on the centre line of the columns, the main trusses had to be divided into two parts, forming identical beams side by side, an arrangement which, incidentally, helped to make the precast units smaller. The arched form of the trusses was found to be suitable for concrete rather than steel, and the system used for both main and secondary trusses is very similar. Each truss consists of two half arches and a tie member. Precast concrete was selected, since it enabled the latticed construction to be used without incurring excessive shuttering costs. It also gave a light construction (the main arches are 12in by 10in in section and the secondary arches 12in by 6in) and overcame effectively the shortage of both steel and timber. The half trusses were cast at the site. The tie members are of prestressed concrete; each main tie member contains 224 2mm wires with a 0·1 per cent proof stress of 125 tons per square inch and an ultimate stress of 150 tons per square inch, and is capable of carrying 70 tons. The reinforcement is similar to ordinary reinforcement, but near the ends, with this type of structure, it would have been difficult to keep to permitted bond stresses if the usual methods of bonding had been applied. Instead, cleats have been welded to the bars, anchoring them by exerting direct pressure on the concrete.

It was decided to keep a factor of safety of 2 on the 0·1 per cent proof stress and the wires of the ties were therefore calculated on a stress of 62·5 tons per square inch, each wire being capable of transmitting $\frac{1}{16}$th of a ton. Each secondary tie carries 35 tons and contains 185 2mm wires. The prestressing was carried out by the Hoyer method. Steel connectors were used to connect the main ties to the columns and the secondary ties to the main ties, as shown in the diagram above. The tie members contain various projections, partly due to these steel connectors, one of which is shown in the illustration on page 299, and partly, in the case of the secondary ties,



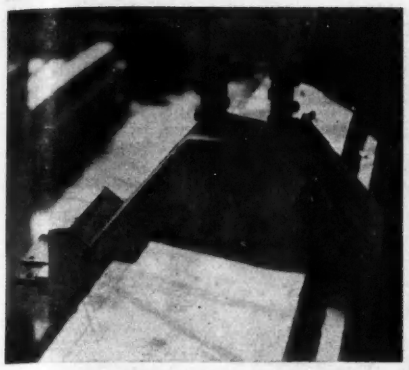
DETAILS OF PRESTRESSED TIE



CONSTRUCTION OF FIRST STAGE IN PROGRESS

due to the requirements for seating the precast concrete construction of the intermediate floor.

It should be noted that only the lower half of the top member of the trusses is precast, and that stirrups are left projecting. The floor construction is composite—that is, the lower part is precast and the top is in *in situ* concrete—giving the same rigidity as *in situ* reinforced concrete. The floor itself consists of specially designed trough units 1ft 6in wide, spanning 8ft 4in, which are laid side by side



TYPICAL PROJECTION FOR STEEL CONNECTION ON TIE MEMBER

and have 1in support on the precast part of the top members of the secondary trusses. These troughs can be seen in the illustration below, laid in position ready to receive the *in situ* topping. The castellations on either side of the troughs are to increase the bond between the precast and the *in situ* concrete. The stirrups projecting from the truss can also be seen in this illustration, although they are not yet bent into their correct final position. The precast units of the service floor may be seen at the top of the illustration; the service floor itself, with the underside of the production floor above, may also be seen in the next illustration.

The whole of the service floor, with the exception of the tie members of the main and secondary trusses, is removable so that alterations in the air-conditioning system can be made freely. The floor is made from precast

PRECAST UNITS OF PRODUCTION FLOOR

beams spanning between the ties of the secondary trusses and flat, precast concrete slabs spanning between them. The total floor thickness is 6in. The slabs weigh about 40 lb each and are provided with dishings and lifting hooks for handling. Special units are arranged in the floor to house strip lights for the production floor below.

THE ANNEXE STRUCTURE

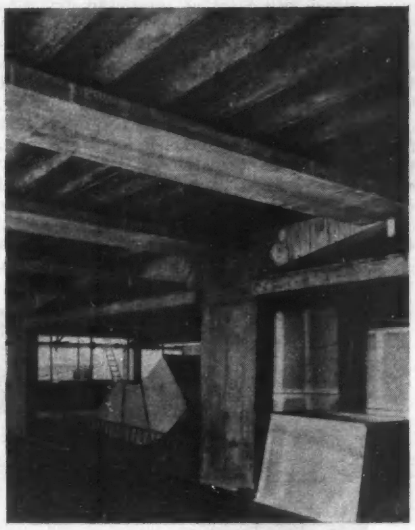
Even in the annexe the problem of space was very acute. There was not the possibility of using the depth of one floor for latticed construction as each floor had to be a construction on its own. While it was possible to have a deeper main beam in every second floor, the floor thickness in the 26ft 4in bays had to be kept within 12in on every floor, which was made possible by the use of prestressed beams. The usual method of prestressing the whole beam was found to be both expensive and unsuitable for the reduced depth, and partly precast and partly *in situ* construction was, therefore, evolved. A prestressed soffit 25in wide and 4in deep was cast on the Hoyer system. These soffits were centrally stressed and each contained 155 wires capable of taking a tensile force of 38·75 tons, and reinforcing steel stirrups to bond with the *in situ* part. Two precast concrete spacing pieces were laid on top of these soffits, one on each side, and trough units, similar to those described before, rested on top spanning from beam to beam. *In situ* concrete was then cast on top forming not only the top of the floor slab, but also the top part of the prestressed beams.

The action of these prestressed beams is such that the compression zone and the centre of the beam are not influenced at all by the prestressing, but the effect on the tension side is much greater than if the beam were prestressed as a whole. The prestressed soffits were found to be very economical, and, in fact, much cheaper than an ordinary reinforced concrete beam. The illustration herewith shows the soffits, and the precast trough units spanning between them. Spanning 20ft between the main columns is another arched construction, also with a prestressed tie member. This occurs on every second floor. The shape of the long rectangular columns, 12in by 36in, shown in the illustration, was dictated by planning requirements.

As mentioned before, the ground at the site was a great source of anxiety. Preliminary investigations were made, using the electrical resistivity method, and this survey showed that there was a very steep fall in the good ground at about the centre of the production building extending right through the annexe. There were two possibilities, either to pile or to excavate the ground right down to the good bearing strata, and the latter procedure was finally adopted in order to provide additional basement space. When commencing the building it was assumed that, based on the preliminary investigation, good ground would be encountered at about 50ft everywhere, and that no ground water would be found. During excavation, however, it was necessary to go down to 62ft at one point, and in fact at that level an old track was found, evidently part of the old pit workings. Also, at one corner of the annexe, a subterranean stream was met at a depth of 40ft. These obstacles made sheet piling and pumping necessary at one point and caused about three months' delay. Otherwise, the work went very well, according to schedule.

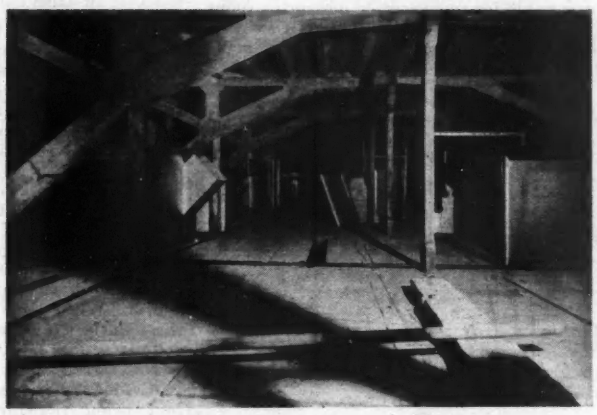
The great height available for the boiler-house, owing to the depth of the excavations, made it possible for the heating engineers to arrange a very economical system, using gravity fed boilers, and solid fuel.

One specific problem with this boiler-house, which was solved in an interesting manner, was the removal of the ash. A 10ft deep trench was constructed below the level of the boiler-house floor connecting to an ash hoist immediately outside the building. The hoist is housed in a shaft, going down to this level, and it brings the ash up to a hopper, from which it can be discharged directly into lorries. Owing to the difficulty of access for lorries, it



TYPICAL ANNEXE CONSTRUCTION SHOWING DEEP BEAM

was necessary to carry this hopper on a canti-lever at ground floor level, with the lorries running down a ramp to a level 11ft below ground floor level. The boiler-house chimney is finally to be 128ft high, i.e., 20ft higher than the building. It is to be built up with the building, which means that at present it is only 60ft high and will be raised when the upper storeys are added. It was positioned at the one corner of the annexe where good ground was found at boiler-house level, and in order to avoid an excessively large foundation the chimney is tied to the annexe building at every second floor by thin slabs, rigid enough to take the horizontal movement, but thin enough to allow the chimney to move independently in a vertical direction.



A SERVICE FLOOR OF THE FACTORY

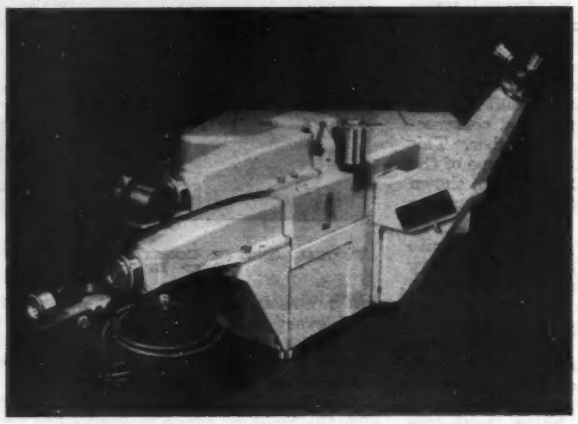
The structure for the first part of the building was completed in twelve months from the time the design started. The consulting engineer was Mr. F. Samuely, and the architect was Mr. E. F. Peat. The contractors were Holland and Hannen and Cubitts, Ltd., and the prestressed concrete members were made by the Concrete Development Company, Ltd.

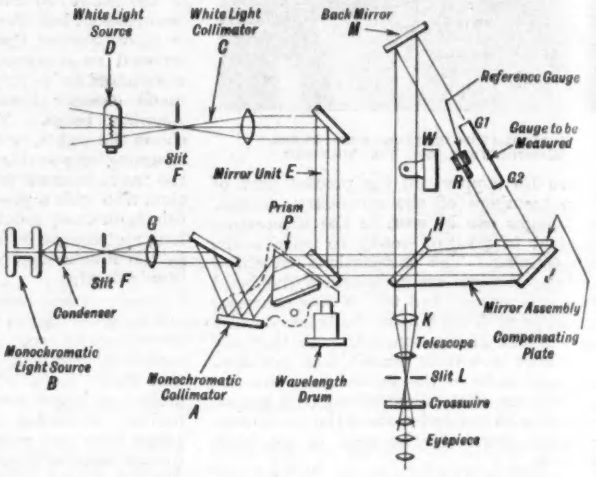
Interferometers for Measurement of Gauges

THE fact that the wavelength of monochromatic light, at constant temperature and atmospheric conditions, is a fixed quantity provides an extremely accurate method of measuring lengths. This system of measurement, which is known as interferometry, has until recently, involved the use of delicate and expensive instruments and the method has been mainly confined to standards laboratories and similar institutions. As the technique of interferometry became more familiar, however, it became apparent that the method might find fruitful application in engineering workshops, provided that the principles of interferometry could be embodied in a simple, reliable and robust instrument. In the tool-room, for example, the method could be used for checking the accuracy of slip gauges, which represent an indirect means of transferring dimensional accuracy from the Imperial Standard Yard to the components being produced in the workshop.

To meet this need for a measuring instrument suitable for tool-room or measuring-room use, Hilger and Watts, Ltd., has designed two forms of interferometer, as illustrated herewith. The first of these instruments, the gauge measuring the absolute length of gauges up to 12in long; it has white and monochromatic light sources and is supplied with the necessary indicating equipment and the associated correction tables for temperature, pressure, humidity.

The main advantage of such interferometers is that no contact is made on the ends of any of the gauges used, so that wear and uncertainty effects are eliminated. The measurement of a gauge usually involves its "working" length, that is, the length of the gauge plus one wringing distance, since the gauge is normally used when wrung to another gauge or surface. Accordingly, the reference gauge for absolute measurement by the interferometer consists of two gauges permanently wrung together. Then, since no contact is made with the ends of the reference gauge, its accuracy cannot be impaired by wear.





FIGS. 1 AND 2—INTERFEROMETER FOR ABSOLUTE MEASUREMENT OF GAUGES

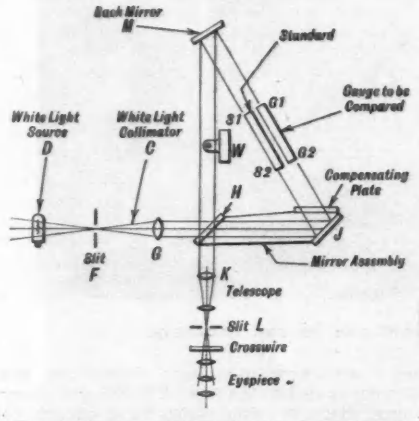


FIG. 3—OPTICAL SYSTEM FOR COMPARISON INTERFEROMETER

comparison interferometer can be used in the tool-room for comparative measurements on gauges up to 10in long. For comparative measurements this instrument is fitted with a white light source but a wavelength conversion unit can be supplied to adapt the instrument for absolute measurement, which involves the use of monochromatic light. The second form of instrument is a gauge interferometer for

GAUGE COMPARISON INTERFEROMETER

Before referring to the interferometer for absolute measurements, shown in Figs. 1 and 2, we shall describe the simpler instrument for comparative measurements.

This instrument is so arranged that both ends of the gauge under test and of a standard gauge can be examined together in the same field of view. By a simple procedure the gauges are adjusted so as to show interference fringes across their faces at both ends and from the relative position of the fringes the equality or difference in length can be measured to an accuracy of 0·000001in.

A plan of the optical system is shown in Fig. 3. White light is projected from lamp D through the slit F, set at the focal length of the collimator lens G by means of which the light is transmitted as a parallel beam. The light is divided by the half-silvered mirror H, one half being transmitted through the mirror on to the inclined mirror J by which it is turned in a direction normal to the end faces of the gauges S and G, which are to be compared. The optical glass plate adjacent to the mirror J compensates for the thickness of the mirror H. The other half of the light beam is reflected at 90 deg. by the half-silvered face of the mirror H to the mirror M, by which it is turned in a direction normal to the opposite ends of the gauge faces. The light is reflected back by the gauge faces S_1 G_1 and S_2 G_2 and on reaching the half-silvered mirror H one beam is transmitted and the other reflected. Both beams are collected by lens K and brought to a focus in the eyepiece.

On looking through the eyepiece both ends of the gauges will be observed, but the mirrors are so arranged that the end faces of the gauges appear to half overlap each other, as shown in Fig. 4. For the sake of clearness in the illustration, the end faces are shown displaced vertically but in practice the top and bottom edges would be approximately level.

The standard gauge S is adjusted so that the end faces S_1 and S_2 are at an equal optical path distance from the dividing mirror H when illuminated by the white light source D. The adjustment is effected by mounting the gauge in a spring holder, its position on the base plate being determined by sliding the holder in a setting fixture as shown in Fig. 5. The holder with the gauge in position is then carefully placed on the instrument, the base plate being set up to stops in two directions. Final adjustment is effected by knurled head traversing screws. When the correct setting is achieved the interference bands, known as "white light bands," will be produced. These bands appear only when the optical paths from the dividing mirror are equal and the exact point of equality is indicated by a prominent dark band, the bands on either side of the central dark band being fringed by colour and successive bands being of diminishing intensity until they become invisible.

The end face G_1 of the gauge to be compared is then adjusted in a similar manner to the standard gauge to bring it into the same plane as the end face S_1 of the standard gauge, so that white light bands are produced on the overlapping halves of the end faces S_1 and S_2 and also G_1 and S_2, as shown in Fig. 4. Obviously, if the gauge G is exactly the same length as the standard S, the faces G_2 and S_2 will also be in one plane and the white light

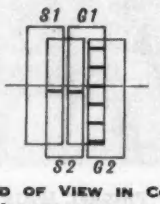


FIG. 4—FIELD OF VIEW IN COMPARISON INTERFEROMETER

bands produced between the overlapping halves of faces G_1 and G_2 will be coincident with those formed by the overlapping halves S_2 with G_1 and S_1. If, however, the length of the gauge G differs from the standard gauge S the face G_2 will not be at the same distance from the dividing mirror H as the face G_1 and the white light bands will be displaced above or below the other two sets of white light bands, the difference in length being proportional to the number of bands and fractions of a band displaced, each band corresponding approximately to a difference in length of 0·00001in. It is therefore only

necessary to measure this displacement in order to establish the exact difference in length.

To enable the displacement to be measured a wire is mounted in the micrometer eyepiece so that a fraction of a band can be measured accurately.

The fringes will also indicate whether the end surfaces are truly parallel and flat, as any departure from parallelism of the end faces will cause the bands to be sloping, the angle of inclination of the fringes indicating the angular direction of the sloping faces. If the surfaces are not flat the fringes will be distorted in accordance with the departure from flatness, forming a contour map of the surface, each fringe following a path of equal height with reference to a true plane surface. To facilitate this inspection the glass block *W* in Fig. 3 can be swung into the light beam so that the gauge end faces can be completely superimposed in the eyepiece. Thus in one operation all the important facts both as to length and quality of the end surfaces of the gauge are exactly indicated.

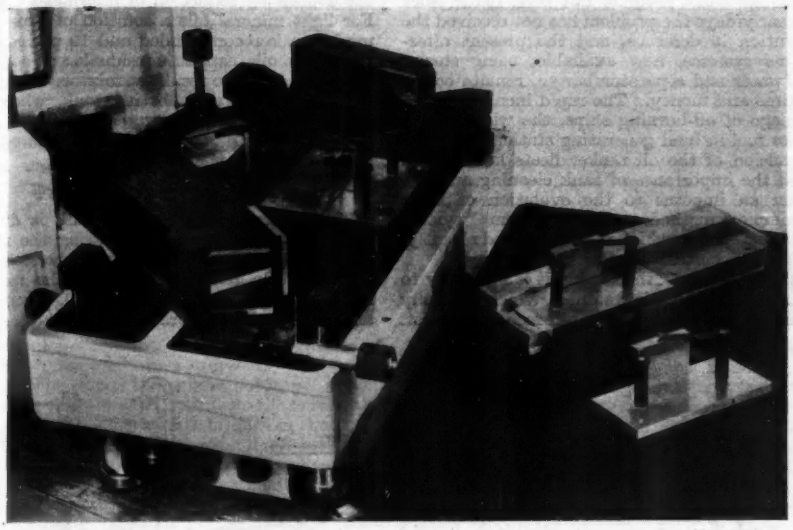


Fig. 5—Optical Parts and Reference Gauges for Absolute Measurement

For absolute measurement a special reference gauge, consisting of a plain gauge and a slotted gauge wrung together, is used. The fixture for setting the gauges on the baseplate is shown at the right.

Interferometer for Absolute Measurement

This instrument (Fig. 1) is similar to the comparison interferometer with the addition of means for introducing special monochromatic light of a suitable number of wavelengths and of a reference gauge of special form. The monochromatic collimator is mounted below the white light collimator, as can be seen on the left of Fig. 1.

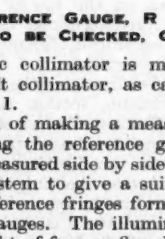


Fig. 6—Reference Gauge, R and Gauge to be Checked, G

The method of making a measurement consists in placing the reference gauge and the gauge to be measured side by side and adjusting the optical system to give a suitable arrangement of interference fringes formed across the faces of the gauges. The illumination is then changed to light of four or five different wavelengths one after the other, the position of the interference fringes being successively noted. Each observation takes about a minute, or four to five minutes in all.

This completes the work on the interferometer, the actual length being computed with the aid of the special slide-rule provided and from a knowledge of the approximate length. The whole operation is simple and well within the capacity of laboratory assistants after a brief training. The accuracy attainable is from 0·000001in to 0·0000005in, depending upon gauge length and the care taken in making observations.

The best light source is a hot cathode Krypton lamp, which enables gauges up to 6in in length to be measured direct, but measurement can be made up to 12in in length in two steps with a gauge of intermediate length to form a secondary standard, which can be supplied as an accessory.

Alternatively the range of measurement can be extended if the Krypton light source is cooled with liquid air to sharpen the spectrum lines and make them more homogeneous. For this purpose a wooden temperature casing containing a thermos flask for liquid air, in which the Krypton lamp can be partly immersed, can be supplied.

A diagram of the optical system of the interferometer for absolute measurement is shown in Fig. 2. A wavelength unit consisting of a prism *P*, and a wavelength drum is mounted between the monochromatic collimator, illuminated by the Krypton lamp *B*, and the beam-splitting mirror *H* on the interferometer.

A white light collimator *C* is mounted above the monochromatic collimator, white light from lamp *D* being introduced as required by a mirror unit *E*, hinged to enter the field when light is required.

Reference to the white light bands can thus be made at any time during measurement without interfering with the adjustment for monochromatic bands.

The angular rotation of the prism provides the means of selecting the desired wavelength of light and this is effected by a drum and screw, which can be seen in the centre of Fig. 1. The drum is clearly marked with the selected set of wavelengths which can thus be introduced as required.

The gauge to be measured is placed in the position of the gauge G_1 G_2 in Fig. 3 and in place of gauge *S* a special "reference gauge" *R*, supplied with the interferometer, is mounted (see Figs. 2 and 5). This gauge consists of two pieces, one slotted, permanently wrung together so that half of the united faces overlap each other as shown in the plan view, Fig. 6.

The appearance of the gauge faces as seen through the observation hole of the telescope *K* is as shown in Fig. 8; the gauge end faces are G_1 and G_2 and the reference gauge faces *C* and *D*.

The reference gauge is mounted and adjusted by means of white light until the faces *C* and *D* (Fig. 6) are at an equal optical path distance from the dividing mirror *H* (Fig. 2), in order to obtain white light bands on the overlapping faces *C* and *D*. Similarly, the gauge to be measured is adjusted until white light bands are obtained on the overlapping faces G_1 and G_2, the two sets of white light bands being adjusted in line horizontally. Under these conditions the faces *C* and *D* of the reference gauge will be exactly midway between the end faces G_1 and G_2 of the gauge to be measured and it is therefore necessary only to measure the distance from G_1 to *D* or G_2 to *C*.

Since the faces G_1 and *D* are arranged to overlap, measurement is made at this end and is carried out by the "fractional band" method by the following procedure.

Monochromatic radiations of selected wavelengths are introduced successively from cadmium or Krypton lamps into the interferometer

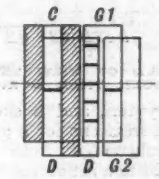


Fig. 8—Field of View for Absolute Measurements

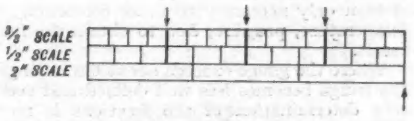


Fig. 9—Fractional Band Method of Deduction

by turning the wavelength drum. The relative position of the fringes as seen on the gauge end faces *G* and *D* being noted in relation to the central band on the reference gauge end faces *C* and *D*, the measurement is made in terms of the spacing of the fringes on end faces *G* and *D*. The displacement is noted for each wavelength of light used, the number of wavelengths required depending on the length to be measured and the accuracy required. The exact length can be deduced by means of a special slide-rule supplied with the instrument, a knowledge of the approximate length of the gauge and the equivalent computed length in terms of wavelengths of the light used.

This method of deducing the length is known as the "fractional band" method and makes use of the fact that if a length is measured by a number of scales, the units of which differ in length, the distance apart at which all the scales will give coincidence of their respective graduations will increase with the number of scales used. As an example, if a ½in scale is placed alongside a ⅝in scale coincidence of graduations occurs every 1½in. If now a third scale of, say, 2in, is placed alongside, coincidence is extended to 6in and so on (see Fig. 9). By a suitable selection of scales and the number used, the distance apart at which coincidence

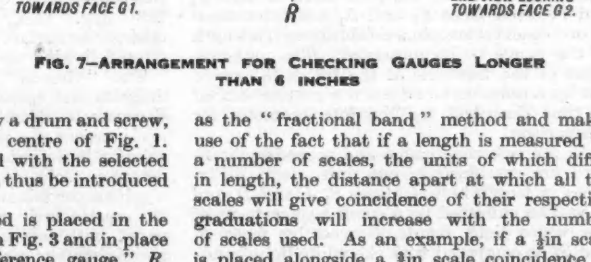


Fig. 7—Arrangement for Checking Gauges Longer than 6 Inches

takes place can be increased to cover a desired range. Thus if the length of a gauge is known to within certain limits, the relative order of the scales over the unknown range can be computed and if by observation the actual order of the units is determined, clearly there will be only one position at which the observed order will coincide with the computed order and the exact length can thus be determined.

A selected number of wavelengths of light gives the desired set of scales a permanent and accurate value and can be regarded essentially as though they were a set of mechanical scales, the division of which varies from 0·000012in to 0·00003in apart. The number of different wavelengths required will depend mainly on the length to be measured and the accuracy required, but usually four or five will be sufficient.

The special slide-rule consists of a number of scales, engraved to correspond to seven wave-

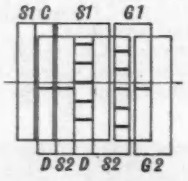


FIG. 10—FIELD OF VIEW WITH GAUGES LONGER THAN 6 INCHES

lengths of Krypton, and a sliding hair line. The calculated fractions for a gauge of correct length are subtracted from the observed fractions and the new set of fractions so obtained are located on the rule with the aid of the hair line. At the point where the nearest combination is found the difference in length can be read off either in inch or metric units. It is then only necessary to make correction for temperature, pressure, &c., to obtain the final result.

Where the gauge exceeds about 6in in length the fringe becomes less well defined and accurate determination of the fractions is more difficult. It is therefore preferable to make the measurement in two steps, and for this purpose a gauge of approximately 5in in length is first measured in accordance with the method described above. The reference gauge is then removed and replaced by the gauge to be measured and the difference in length determined by a similar procedure.

This method can be simplified by using a secondary standard and reference gauge combined in one piece, of a total length of approximately 5in. This kind of gauge can be supplied as an accessory. The combined gauge and the gauge to be measured are mounted side by side so that the length of the secondary standard and difference in length between the secondary standard and the gauge to be measured can be determined at one observation. The arrangement is shown in Fig. 7. The appearance of the field of view with this combined gauge is shown in Fig. 10, in which the faces C and D are those of the reference, S_1 and S_2 the secondary standard, and G_1 and G_2 the gauge to be measured.

White light bands are obtained between faces C and D, S_1 and S_2 and G_1 and G_2, thus establishing that the end faces are all symmetrically disposed, then, by monochromatic light, the distances between faces D and S_1 and between faces S_2 and G_1 are determined at one observation, thus establishing the length of the gauge to be measured. The measurement of the fractions of the bands is carried out by a cross wire and a screw motion similar to that described for the interferometer for comparison.

As the reference gauge and secondary standard are combined in one unit, slight differences in length between faces S_1, C and D, and S_2 will be indicated by a small displacement of the white light bands, formed by faces S_1 and S_2 as compared with the white light bands formed by faces C and D, but this is taken into account since the fractional bands are measured in reference to the central white light band formed between faces S_1 and S_2. Both kinds of interferometer are supplied without illuminants for monochromatic light but alternative lamps are available.

In addition to checking lengths, means are provided for testing the flatness and parallelism of the end faces of the gauge to be measured. By swinging into the light beam the glass block W (Fig. 2), the whole area of the gauge end faces can be superimposed. Alternatively one end face of the gauge to be measured can be superimposed on one end face of a standard gauge.

A Cleaning System for Oil Tanks

THE cleaning of oil tanks has been always a long and costly process, involving considerable delays in port for the vessel concerned. Although some progress has been made since the early days the problem has not received the attention it deserves, and the present alternative systems, now available, using steam, hot water and separator barges, remain costly in time and money. The rapid increase in the tonnage of oil-burning ships, the wider use of oil as fuel in land generating stations, and the expansion of the oil tanker fleets has emphasised the importance of tank cleaning and has given an impetus to the evolution of more economical methods. The "Groom" system of tank cleaning, which was announced recently, will be of considerable interest to many.

To clean a tank thoroughly it is necessary to remove the asphaltic residuals, which generally consist of oxidised oil, bitumen and rust. Whatever the principal method employed hand cleaning has remained a necessity for cleaning corners. Current methods, requiring high-pressure pumps and heat exchangers, involve the use of large quantities of water at about 200 deg. Fah., directed under pressure against the surface to be cleaned—an operation often following the steaming of the tank.

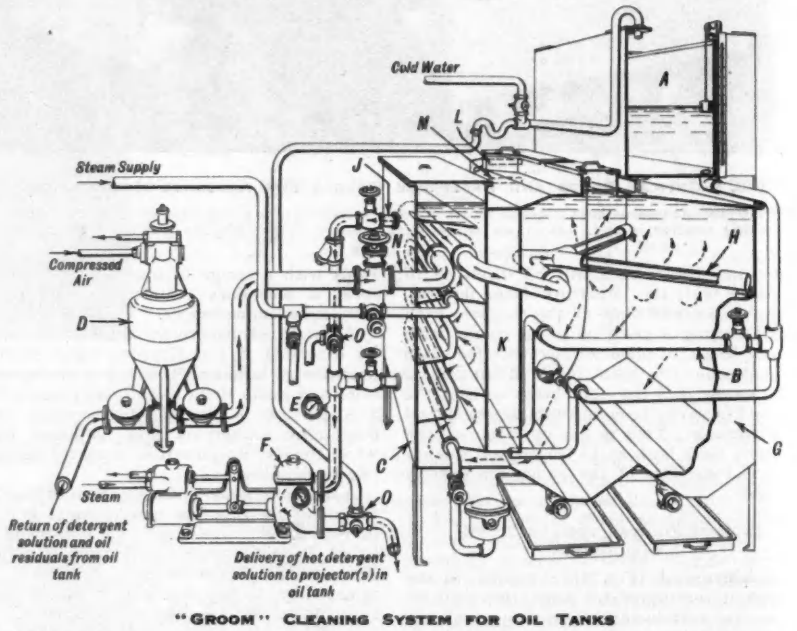
The "Groom" system, illustrated in our diagram and sponsored by the Groom Patents Company, of Bromley, Kent, is entirely different and consists of a plant in which a detergent in solution in water is used in a closed circuit. The detergent solution is sprayed at the rate of 4 gallons per minute at 150 deg. Fah. and 100 lb per square inch pressure, which can be compared with current requirements, which are approximately 400 gallons per minute of hot water at 200 lb per square inch. In the new system the aqueous detergent is heated and pumped to the operating point, where it is discharged through a specially designed projector, with a variable range. The detergent, generally a degreasing alkali containing a synthetic wetting agent, is usually in a concentration of between 7½ to 10 per cent and removes the deposit by reduction of interfacial tension. For light mineral oils a solution of 5 per cent minimum is recommended and 10 per cent for heavy fine oils, asphaltic residuals and cod liver oil residuals. The resultant mixture is pumped to a separating and heating tank, where the detergent solution separates out and, after having any loss made good, is reheated and pumped back to the projector.

DESCRIPTION OF THE PLANT

The separator and heating tank is divided into two parts, one for separating the return mixture and the other for heating the reclaimed solution. On reaching the tank the mixture flows through a pipe within the heating tank and the rise in temperature stimulates separation and thermal flow. After this stage the hot liquid passes via troughs to the separating tank, where the solids sink to the bottom and are removed through quick-opening valves. The oil accumulates on the top of the detergent solution to a predetermined depth, which is automatically controlled, then overflows through a slot into a recovery drum.

An air chamber insulates the heating section from the separating section to prevent any thermal flow affecting effective separation. The reclaimed detergent solution passes under the air chamber to the heating section, where baffles guide it over heating elements which raise its temperature to approximately 150 deg. Fah. This temperature is easily maintained, since the rate of discharge of the detergent solution, the downward flow in the separating tank and the upward flow in the heating tank are all constant.

A make-up tank is mounted above the main tank and contains detergent solution of operating strength, which is admitted to the system



"GROOM" CLEANING SYSTEM FOR OIL TANKS

A. Make-up tank
B. Make-up pipe
C. Heating section
D. "Ejectopump" returns (Detergent/oil/residuals)
E. "Rototherm"
F. Detergent solution delivery pump
G. Separating section
H. Returns discharge trough
J. Detergent solution pump suction pipe and valve
K. Insulating section
L. Overflow slot
M. Overflow slot immersion tank
N. Returns pipe
O. Three-way cocks

through a valve automatically actuated by a low-level limit float. This guards against the possibility of oil passing into the heating section should the returns consist mainly of oil.

The projector is hand operated and consists of two nozzles, which can be used simultaneously, one to project a long unbroken jet and the other a jet of fishtail form. A unit with a tank measuring 5ft by 4ft by 5ft is suitable for operating four projectors together, each discharging 4 gallons per minute. The detergent solution delivery pump must have a capacity of 16 gallons per minute of solution at 150 deg. Fah. and maintain a pressure of 100 lb per square inch at the point of discharge, while the returns suction pump must raise 30 gallons per minute of contaminated detergent solution through a nominal head. A supply of steam at 100 lb per square inch is required and the steam consumption amounts to 250 lb per hour for a detergent solution pump of 16 gallons per minute and 800 lb per hour for heating purposes, while the compressed air supply for the returns pump amounts to 20 cubic feet of free air per minute when using four projectors.

Ship Installations

The "Groom" tank for installation on board ship embodies certain modifications so that it will function with the ship rolling and pitching. Anti-surge covers are fitted, which have upward sloping plates forming a cone converging to a centrally disposed riser pipe or anti-surge turret. The slope of the plates is 15 deg., which allows for this amount of tilt from the horizontal and ensures that none of the liquid in the body of the separating and heating tank can flow through the reclaimed oil overflow slot and no detergent solution can spill through this slot. By a special adaptation the system can be used for degreasing parts of oil coolers and condensers and also engine parts. The adoption of the system, it is claimed, effects considerable economies, and the Groom Patents Company gives cost comparisons based upon a number of actual jobs, one of which will serve to illustrate the order of the savings in man-hours. The time taken to clean seven tanks of 1000 tons and fourteen tanks of 50 tons in a 12,000-ton tanker by hand labour was 14,400 man-hours spread over four days. Using the "Groom" system and four projectors it is estimated that 198 man-hours would suffice and, in addition to the reduction in labour charges, the ship would be laid up for a considerably shorter time.

The Building Research Congress, 1951

On Tuesday next, September 11th, the opening session of the Building Research Congress will take place in the Great Hall of the Institution of Civil Engineers, where an address of welcome will be delivered by Viscount Samuel. The Congress will be in session until September 20th, during which time eighty-eight papers from a number of countries will be read. A large number of visits, both to places near London and further afield, have also been arranged for those attending the Congress. For the purpose of the technical sessions, the Congress has been planned in three divisions, holding concurrent meetings. A brief summary of the papers in each of these divisions is given below.

Division I.—The engineering and structural aspects of building are covered in this division. Part I, in which there are six papers, is concerned with the influence of mechanisation and prefabrication on the techniques and costs of building and is concerned mainly with houses and small dwellings. Part II, however, is devoted to the influence of modern research on structural design, which is an engineering subject. Similarly, Part III, which is about the influence of modern soil studies on the design and construction of foundations, will be of considerable interest to civil engineers. There are twelve papers in Part II and six in Part III.

The general review in Part II is by G. Wastlund, of the Swedish Cement and Concrete Research Institute, Stockholm. There are four papers on reinforced concrete construction. The first is by H. Granholm, of Sweden, and is entitled "Modern Developments in Reinforced Concrete Design and the Influence of Research." Professor Granholm describes methods of increasing the admissible steel stress in reinforced concrete, without causing excessive cracking. He goes on to state that the classical method of design based upon a fixed modular ratio (usually $n=15$) is not adaptable to a correct interpretation of the ultimate bearing strength of a beam, and new methods have been developed to replace it. The three other papers on concrete structures are all from Great Britain and are entitled: "A Review of Research on Reinforced Concrete," by F. G. Thomas; "Research and the Development of Prestressed Concrete," by A. R. Collins, and "Shell Construction," by A. L. L. Baker. These papers review existing knowledge, describe research work which has been carried out in this country, and indicate where research is likely to be worth while in the future.

There are four papers on steel construction, namely: "Trends in Steel Design and Research," by G. Winter (U.S.A.); "Some Practical Problems facing the Designer in Structural Steelwork, with particular reference to the Steel-framed Building and the help given by Research," by F. A. Partridge (Great Britain); "A Review of Research on Structural Steelwork, with particular reference to the Behaviour of Structures beyond the Elastic Range," by J. F. Baker (Great Britain), and "The Needs of Research on the Application of Welding in Steel Building Structures," by F. Campus (Belgium). As may be seen from the above titles, a good idea of the present state of research in steel construction is given by these papers.

Part II of the first division also contains two papers on timber structures: "A Review of the Structural Use of Timber in the United Kingdom," by P. O. Reece, and "Research on the Structural Use of Glued Laminated Timber," by C. F. Morrison (Canada)—which are of considerable interest, in view of the advances which have been made in the structural use of timber during the past few years. Another material which has also received a great deal of attention recently is aluminium, and the last paper of this section outlines some of the research work, concentrating mainly on that of direct interest to the building industry, which has recently been carried out. It is entitled: "Some Research Contributions to the Design of Light Alloy Structures," by A. G. Pugsley (Great Britain).

Turning now to Part III of the first division, there are six papers on soil mechanics. The first of them, "Building Foundations in Theory and Practice," by K. Terzaghi (U.S.A.), presents an interesting review of the subject. Three of the papers are from British authors and are entitled: "The Influence of Modern Soil Studies on the Construction of Foundations," by H. J. B. Harding and R. Glossop; "Some Foundation Problems in Great Britain," by L. F. Cooling, and "The Bearing Capacity of Clays," by A. W. Skempton. "Special Foundation Problems in Canada" is the title of a paper by R. F. Legget, and the sixth paper of the group is: "Application of Results of Deep Penetration Tests to Foundation Piles," by T. K. Huizinga (Holland).

Division II.—The second division is concerned with building materials and there are twenty-three papers, covering the study of individual materials, such as burnt clay products, cement and concrete, building stones, lime, paints, plaster and timber. A great deal of information is also included about research on the weathering and durability of building materials.

Division III.—There are four parts to the third division, which is devoted to the efficiency and comfort provided by different kinds of buildings. The first part is entitled: "The Acoustics of Auditoria and Studios," in which there are ten papers, ranging from a description of the acoustic design of the Royal Festival Hall to papers on sound absorption and acoustics in broadcasting.

Part II is about the heating and ventilating of buildings and is in four parts, with three "theoretical" and three "experimental" papers, two on "Building Construction" and three on "Plant Design and Operation." The lighting of buildings is discussed in Part III, under the headings of brightness and glare, lighting of schools and factories, daylight, and colour. Part IV contains papers on the problems of specific sorts of buildings, there being three papers on hospitals, three on factories and two on schools.

It will be seen that a very wide range of subjects is covered by the Congress, many of the papers being of considerable interest to the engineering profession. The address of the organising secretary of the Congress is 57, Onslow Gardens, London, S.W.7.

Literature

SHORT NOTICES

Isothermal Transformation Diagrams for Nickel Steels. Published by the Mond Nickel Company, Ltd., Sunderland House, Curzon Street, London, W.1.—The high scientific value of the publications of the Mond Nickel Company is widely recognised, and has never been more evident than in this small booklet which describes the results of determinations, made in its own research laboratory, of the isothermal transformation data of more than a dozen B.S. En. steels containing nickel in various amounts with or without other alloying elements. The clearly recorded and fully annotated isothermal diagrams may with advantage be used to supplement the Iron and Steel Institute's Atlas of Isothermal Transformation Diagrams, published in 1949, and the value of the book is greatly enhanced by a twenty-five-page introduction in which the methods of determination of the diagrams, their general character, and their usefulness in laying down conditions of heat-treatment of the steels (including special heat-treatments such as austempering and martempering) is lucidly explained and illustrated by some excellent photomicrographs.

Progress in Metal Physics. Vol. 2. Edited by Bruce Chalmers. 1950. London: Butterworth's Scientific Publications, 436, Strand, W.C.2. Price 45s.—The second volume of this annual series follows the plan of the first in presenting authoritative reviews of the present state of knowledge in specialised aspects of physical metallurgy and metal physics. The subjects treated in this volume are order-disorder changes in alloys, rate processes in physical metallurgy, anisotropy in metals, developments in magnesium alloys, and (in three papers on closely related aspects of the subject) polygonisation, which occurs when, within each grain of a metal subjected to deformation, the lattice rows are not continuously bent, but are broken into small segments, each of them making small angles with its neighbours. These reviews, each by an acknowledged expert, will render invaluable assistance to all students of metal physics. In selection of subjects, a balance is maintained between those which at present are mainly academic and those with a more practical bearing.

The contributions of most direct interest to the engineer are probably those on rate processes and on magnesium alloys. The essay on rate processes in physical metallurgy covers a wide range of metallurgical processes linked together in terms of the concept of "activation energy." Diffusion, precipitation by nucleation and growth, flow of solid metals, stress-strain relationships, creep, strain hardening and recrystallisation are dealt with. The review of magnesium alloys traces the thirty years' development of alloys of magnesium with manganese, aluminium and manganese, and aluminium, zinc and manganese down to the more recent products containing cerium or zirconium, and finally to the magnesium-lithium alloys whose remarkable physical and mechanical properties may yet prove to be of use to the aircraft engineer. The editor and contributors are to be congratulated on having worthily maintained the high standard of the first volume.

THE ENGINEER

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A METHOD OF STUDYING HUMAN PROBLEMS

THERE are plenty of books on management, foremanship, works relations and the like. Our own bookshelves bulge with them. Many more are still likely to be written. For there is no end to a subject concerned fundamentally with the problem of making human beings, with all their vagaries and inconsistencies, co-operate together in a purposive organisation. Yet it is all very well to set down principles in books. In fact, it is not at all easy to apply those ideal principles to individual cases. That is a point that has been well appreciated by the Industrial Welfare Society. By the courtesy of that Society we were recently able to see a method that has been devised to make it possible for junior executives to discuss, not principles, but particular cases and perhaps derive from them general principles of wider application. In a film-strip, accompanied by a gramophone record, there is told the simple story of a series of events upon a factory floor involving a few named (though, of course, fictitious) characters. Each such story is credible in itself and is made to seem all the more real by "seeing" the people concerned on the screen and hearing them talk. In each story something goes wrong with the relations between the people so portrayed. But no ready-made answer is offered to the problem so set. Only the question is asked of the audience: "What would you do?" The audience is left to discuss the point, some guidance being given to a "discussion leader" by a printed list of some, at least, of the points that may prove worthy of consideration. We are informed—and can very well believe it—that some of these film-strip problems create as much as sixty to ninety minutes of animated discussion, not only as to what has gone wrong but, more importantly, as to what should be done, and by whom, to put matters right. For we were covered with admiration for the ingenuity with which simple yet intriguing situations, enshrining common circumstances that could be paralleled in almost any factory, are described and illustrated with extreme brevity of detail.

Quite obviously from the demonstration we attended moving pictures such as are seen in a cinema are quite unnecessary for the purpose in view. The still pictures and the voices are quite sufficient to bring the individuals portrayed to life. Indeed, they come so well to life that we can well imagine a member of the audience, in discussing the actions, say, of Mr. Arthur Stevens, the shop steward portrayed in a story, going out of his way to temper criticism, lest Mr. Stevens be too deeply offended! A library of such film-strips is being built up, under the general title "Human Problems at Work," with the intention that the strips and gramophone records shall be available to members of the Industrial Welfare Society to help in training within industry. The purpose of the present series is to present controlled situations so devised as to confront the audience with typical problems in human relationships on the factory floor. Of the strips that we were privileged to see, most were concerned with such problems as a foreman might be expected to meet. But one dealt with the activities of a woman "supervisor" and another ended with the question: "What should the personnel manager do?" Some fifty firms, we are informed, have so far used these film-strips. When they have been presented to large audiences a suitable number of small syndicates has been formed for the purposes of discussion. The Society provides no set answers to the problems discussed. We were, however, interested to learn that usually up to 90 per cent of those who have seen a problem presented arrive ultimately at the same conclusions as to the way the situation portrayed should have been handled and as to what should be done to put matters right. Very few favour either the brandishing of the "big stick" or the offer of the "carrot."

So far, we believe, these film-strips are intended only for showing to foremen and junior executives. It occurs to us, however, that there are other fields in which they might prove valuable. The work of a student at a university, for instance, is divorced from human considerations. Yet upon graduation and entry to a works and still more in later life as an executive the same young man is bound to encounter many human problems. Could space be found in a curriculum for the occasional showing of such film-strips to demonstrate that the technical are not the only problems that young engineers will be called upon to solve in later life? Again, it seems to us that top executives as well as their juniors might profit from the discussion of suitable problems presented by the film-strip technique. It is true that it would not be altogether easy to devise suitable stories. For top executives sometimes have to struggle with problems in human relations that are scarcely soluble. Yet we do suggest that the presentation of case histories by this technique—or rather the discussions they provoked—might show that higher executives, like their juniors, find it easier to discuss particular cases and derive thereby general principles than to apply general principles to particular cases. At the least we recommend to higher executives that they should see examples of these film-strips as soon as may be and discover whether, quickly, they could reach wise decisions upon the situations portrayed! For our part, we found our mind immensely stimulated by them.

INTERPLANETARY FLIGHT

IT is startling to the ordinary engineer deep in the study of technicalities that are likely to have immediate applications in practice to find that other men, technically as well educated, should consider interplanetary journeys feasible in the not distant future. Yet to those engineers who have had the opportunity to study the development of rockets during the war and since, the suggestion does not seem so visionary. Indeed, this week, as we note elsewhere in this issue, there is being held in London, organised by the British Interplanetary Society, an International Congress on Astronautics, at which a number of truly technical papers on interplanetary flight are being presented for discussion. At that Congress an International Astronautical Federation has been set up to promote the achievement of space flight as a peaceful and not a military project. Nor have the discussions at the Congress been as diffuse and visionary as might be expected. Study of the subject of flight amongst the planets has, in fact, already proceeded so far that the Congress has deliberately chosen to restrict discussion on this occasion to the single theme of the "earth-satellite-vehicle." Such a "vehicle" would be an artificial satellite moving in a true orbit a few hundred miles above the surface of the earth and held in that orbit, just as the planets are held in orbits around the sun, by the balance between the central gravitational attraction and centrifugal forces. No rocket motor or other source of power would be needed to support the "vehicle" once established in its orbit.

The project for the establishment of one

or more earth satellite vehicles may seem fantastic. Yet those who are studying the project are not, like John Wellington Wells, dealers "in magic and spells." The American Government, for instance, is seriously studying the possibilities for practical purposes of establishing such a "vehicle." It may be suspected (regretfully) that it has more in mind its possible military uses than such peaceful and scientific uses as it might possess as an aid to the study of meteorology, cosmic rays, &c., or in the role of a radio relay station. Yet no government is likely to spend money on such an investigation unless it believes that practical results may follow, and that they may follow soon. In fact, an assessment of what has already been done by rockets in relation to what needs to be done in order to establish an earth-satellite-vehicle reveals very clearly that the establishment of such a body is not far off the bounds of present technical possibility. An earth-satellite-vehicle a few hundred miles up would need to travel at a speed of some 18,000 miles per hour. It sounds a very high speed, indeed, as compared to those of conventional aircraft which are only now beginning to break through the sonic barrier at 700/800 m.p.h. But rockets have already climbed to heights exceeding 200 miles and they have reached speeds of about 5000 m.p.h. Moreover, the modern study of rocket problems, though begun long before the war, only became intensive during the war. Further development can reasonably be expected to be relatively rapid. Within the sphere of rocketry in fact, much practical experience has been, and is being, gained by engineers. But, at the Congress, discussion has gone far beyond rocketry alone. Necessarily, therefore, it has been academic and to the ears of earth-bound engineers whose hopes and theories have constantly to be aligned with practical experience, some of the papers and discussions have sounded a little woolly and unsatisfactory. There has been, for instance, talk of new propellants and new methods of propulsion as yet untried; a project for an expedition of about fifty men to Mars has been worked out in detail and calculated to cost an amount small in relation to current armament budgets; the possibility of two kinds of space-flight vehicles is envisaged, one designed specially for journeys between the earth and an earth-satellite-vehicle, and the other for travel between satellite vehicles; the chances of a space vehicle colliding with meteors have been calculated. All this work has been based upon such scientific facts as are known about space travel. Yet, without that practical experience, which alone makes such calculations concrete, much of it retains a visionary flavour unsatisfactory to engineers.

But why should men want to leave this planet and travel in space? We cannot help wondering. For the airless moon, overheated on its sunny side and terribly cold on the other, does not seem an attractive destination. Venus appears for ever wrapped in a dense pall of cloud through which sunlight, probably, penetrates only dimly to any solid surface it may possess. Mars, according to recent investigations, may possibly have some vegetation; but at best it must be arid and bereft of sufficient oxygen to support human life. The great outer planets, Jupiter and Saturn and perhaps Uranus and Neptune, too, are believed to have atmospheres of unpleasant methane gas, and their satellites may be no more attractive than balls of ice! There does not seem to be any Eldorado here, such as men could dream of discovering after Columbus came back from the New World. For our part therefore we feel engineers should set their sights low. Let us stick to the more immediately practical. The technical problems in the design and operation of space vehicles are certainly intriguing. But practical experience, at present unobtainable, affords the only test of the validity of calculations. Without the test of experience it is difficult to distinguish the fantastic from the practical. Through the natural development of rocketry there will come, perhaps within a decade or so, the practical possibility of establishing an earth-satellite-vehicle. When practical experience has been obtained with such a vehicle, whose scientific uses can be clearly envisaged, it will be time enough to think seriously how to make the next step forward and whether it is really worth taking.

Obituary

GILBERT COOK, F.R.S.

OVER the last forty years Professor Gilbert Cook has made a valuable contribution to engineering education in the Universities of Manchester, London and Glasgow. His death, which occurred on August 28th, at the age of sixty-five, will be deeply regretted. Since 1938 he had been Regius

PROFESSOR GILBERT COOK

Professor of Civil Engineering and Mechanics at Glasgow University.

Gilbert Cook was born at Blackburn, Lancashire, on October 26th, 1885. He received his general education at the Public Higher Grade School, Blackburn, and at Roomfield Secondary School, Todmorden, and then studied at Manchester University, where he graduated with first-class honours in engineering in 1905. For the next four years—during which time he obtained his M.Sc. Degree at Manchester University—Cook served an apprenticeship with the late D. C. Rattray, chief engineer of the old Lancashire and Yorkshire Railway, and for a year thereafter he was an assistant engineer on that railway. In 1910 he was elected to a Research Fellowship at Manchester University, founded by the Vulcan Boiler Insurance Company, and in 1911 he was appointed a lecturer and demonstrator in engineering at the University. That appointment marked the beginning of Gilbert Cook's distinguished career as a teacher of engineering.

When war broke out in 1914, Cook joined the Royal Garrison Artillery, with which he served as a Lieutenant for three years. In 1917, however, he transferred to the R.N.V.R. in which he was engaged on special experimental work associated with minesweeping. Cook continued with the R.N.V.R. until 1919, and in September of that year he was appointed senior lecturer in engineering at Manchester University, taking charge of the organisation and supervision of all laboratory work. The Degree of Doctor of Science was conferred on him by Manchester University in 1920, and in the latter part of that year Cook was called upon to act as adviser on design, lay-out and manufacture of hydraulic equipment needed for the University of Cape Town. Dr. Cook left Manchester in September, 1921, on being appointed to the Chair of Mechanical Engineering in the University of London, tenable at King's College. He remained there until his appointment to Glasgow University in 1938 as Regius Professor of Civil Engineering and Mechanics.

Dr. Cook was a Member of the Institution of Civil Engineers and the Institution of Mechanical Engineers and at the time of his death was President of the Institution of Engineers and Shipbuilders in Scotland. He made many contributions to the proceedings of learned societies and to the technical press, dealing with his researches in various branches of engineering, particularly in the strength and elasticity of materials. Dr. Cook's research work was widely known and was deservedly recognised by his election in 1940 to the Fellowship of the Royal Society.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE RETURN OF THE NATIVE

SIR,—To enjoy nowadays the "simpler, pleasanter and more carefree" rail travel for which Mr. Livesay calls in the last sentence of the letter published in the August 17th issue of THE ENGINEER, he would have to patronise either the Swiss or the Swedish railways or else the Italian "Rapido" trains which only admit their passengers upon the payment of a supplement appropriate to the class and distance they intend to travel. These three railway systems incidentally provide electric traction; that is, smokeless and "cinder-free" runs over very long distances. But perhaps Mr. Livesay, afraid of cinders being blown in his or the driver's eyes, which should be protected anyway by goggles to be provided by the National Health Service, would prefer to be coated from head to foot with the very fine soot I experienced when travelling behind an American-built oil-fired locomotive of the French National Railways.

Apropos the French Railways, it is a matter of regret to me that Mr. Livesay appears to have had no opportunity so far to travel (as a non-Pullman, full fare and supplement paying ordinary passenger, that is) by their so highly publicised crack train "Le Mistral." If he had done so, he might possibly have been more

satisfied with British trains and complained less or, better still, not at all about them.

"Le Mistral," Monsieur Livesay, that train, it runs at 130–140 km.p.h. (80–86 m.p.h.) over the electrified section from Paris to Dijon; but as for roomy and comfortable travel, that is another story! The number of passengers carried by the "Mistral" regularly appears to exceed twice the quantity of seats available, so that each trip I made by it reminded me forcibly of my worst wartime rail journeys in England. Mr. Livesay is annoyed "to the point of madness" because he did not get easy and comfortable access to the dining car (and elsewhere). Well, he may not need to bother finding his way through the crowded corridors and over the stapled "valises" in the vestibules of the "Mistral" carriages, as all the many meal sittings would probably be fully booked up before he even had a chance to board the train.

It was on the "Mistral" that I also suffered an illustration of the combined effects of gravity and deceleration (by means of speed-controlled compressed air, not vacuum, brakes) when applied to a suitcase on an overloaded luggage rack, to the intense, though fairly well-suppressed, mirth of the lady sitting opposite me, whose amusement at my discomfiture only added the proverbial insult to my injured physical feelings.

As for Mr. Livesay's suggested remedy of running longer and heavier trains on British Railways, hauled by Beyer-Garratt. loco-motives, this would obviously entail either the enormous expenditure required for lengthening the platforms and appropriate resignalling, &c., or else the unavoidable delays resulting from trains having to pull up twice at platforms of existing lengths to accommodate the increased number of coaches.

One remedy, but of very doubtful value, as French experience proves, is either to levy a supplement for the use of certain trains or to make their access subject to travel for a minimum distance, or a combination of both.

May I conclude by respectfully inquiring from Mr. Livesay whether he is aware that though "there is a peace on" we are all busily engaged preparing against the possibility of still another bigger and better war?

C. CARTY

London, W.C.1, August 20th.

PRESENT-DAY LOCOMOTIVE WORKING IN GREAT BRITAIN

SIR,—I am grateful to Mr. M. G. Smith (August 3rd) for correcting my faulty reasoning with regard to the conditions under which a locomotive burns least coal. It would be extremely interesting to see figures for the "Castle" class locomotives, giving, under several different conditions of loading, the speeds at which the thermal efficiency is highest and the coal consumption a minimum. These should, surely, be as nearly equal as possible. I am aware that these figures could be obtained from the diagrams in Mr. Nock's recent article, but owing to the smallness of scale used, the job would be very tedious and the results lacking in accuracy. Perhaps Mr. Nock will be able to provide them.

If I may be allowed second thoughts on the subject, I feel that it may be the figures given by the British Railways testing staff for the St. Pancras to Manchester train that are "wrong," in so far that they are only intended to apply to journeys not subject to out-of-course checks. The effect of any such checks can either be assessed as time, which is frequently done by recorders of locomotive performance such as myself, or as the extra coal used. The different units employed merely represent two ways of expressing the same thing.

Like Mr. Smith, I agree that a considerable decrease in coal consumption could be obtained by speeding up freight trains and in all probability the coal saved would more than equal the amount used to work the ejector—some 40 lb an hour. The other immeasurable benefits arising from the fitting of continuous brakes on freight trains need not be touched upon here. Incidentally, one wonders why a cross-head vacuum pump such as that fitted universally to the locomotives of the Western Region, does not find more widespread use, in view of the contribution it must make to coal economy. To produce a given vacuum, whether by ejector or pump, requires a certain amount of energy, which is normally supplied through the boiler. However, on falling gradients the cross-head pump does not use any steam, some of the train's potential energy being utilised instead of otherwise being dissipated by the brakes. Also, surely, an ejector, although of simple construction and without any moving parts, uses steam less efficiently than a pump. In addition, a pump has the ability to keep the brake off under conditions of low boiler pressure, when an ejector would begin to fail.

I must apologise for not having realised that the G.W.R. set an example over the use of springs to balance the reversing gear. Unfortunately I have never had the opportunity to delve sufficiently deeply into the "works" of their locomotives and have missed noting the use of springs. By contrast, "Britannia" and her sisters are extremely ostentatious. Only last week I rode on a Worsdell Class "J21" 0–6–0 of the N.E. Region, which had two balance weights weighing about 120 lb between them. Until recently this class had a monopoly of the workings over the line from Darlington to Kirkby Stephen. Every journey, therefore, this needless weight had to be lifted about 1200ft and the energy used dissipated in the brakes during the descent.

PETER W. B. SEMMENS

Middlesbrough, September 3, 1951.

THE CLOSING OF BRANCH LINES

SIR,—The daily Press reports an increasing number of British Railways branch lines either closed for passenger traffic or scheduled for closing. Various reasons are given for this action, for example, shortage of staff; alternative means of transport by bus, unremunerativeness, &c. Furthermore, it has been put forward that it is more efficient to run fewer and longer trains, but, whereas this may be true economically, it is definitely not the right approach to the problem of local service. One reason for the popularity of the bus is frequency of service and usually its lower fare.

With reference to the provision of bus services as the sole transport for country services, one is tempted to doubt whether any of the Transport Executives have travelled by bus under the conditions of severe fog; frozen snow, such as was experienced during the 1950–51 winter; with a baby in a perambulator; with a large dog (carried only by conductor's permission), or with heavy luggage.

A contemporary journal illustrated, earlier this year, a very simple four-wheeled railcar driven by an oil engine and gearbox very similar to, if not identical with, the normal bus equipment, and therefore one would imagine costing very little more than a road vehicle. In order to provide a satisfactory service on branch lines with the minimum of staff, the following suggestions are put forward from the viewpoint of potential passengers:—

(1) Equip the line with a railcar based on the previously mentioned chassis fitted with a body seating, say, thirty-six persons, and, most important, having a clear floor space for perambulators, luggage, dogs, &c.

(2) Staff the car on bus lines, i.e., with driver and guard/conductor, the latter selling tickets *en route*.

(3) Close all booking offices on the route, transferring the staff to more important centres.

(4) Provide a number of halts or request stops, consisting of very short platforms with shelters similar to those provided by bus companies.

(5) Run the line on the "one engine in steam" principle, fitting goods trains into slack periods.

(6) Close all signalboxes other than at junctions with other lines.

By this means it is suggested that the public would be provided with an efficient service which would suffer the minimum interference by weather, &c. Finally, I would like to make it clear that I have no connection with any firm constructing railcars. Should you find space to publish this letter, the opinion of your correspondents on railway matters would be appreciated.

S. T. SAUNDERS

St. Albans, Herts, August 21st.

MECHANICS APPLIED IN ENGINEERING

SIR,—I have read with much approval Prof. W. A. Tuplin's letter in your issue of August 24th, and particularly the penultimate question in his first paragraph.

At the beginning of the last war British engineers made war material of all kinds to standards of excellence of materials and finish that took no account of the expectation of life of the equipment or component. After a time it was recognised that this was an uneconomic procedure and requirements were so modified that cheaper materials, less finish and higher stresses could be used where records showed that the chances of war made long endurance unnecessary.

As I understand him, Prof. Tuplin is now asking that the same principles should be, at least, examined in the design of peace-products. He takes the stresses on gear teeth subjected during their probable life to a relatively small number of applications, as an example, and, no doubt, has in mind other details of machinery that would equally bear scientific examination. Perhaps general engineers might learn something in this regard from agricultural engineers, who, faced with the problem of combining fitness with endurance and cheapness, have evolved methods and designs of great interest.

The general principle to be followed would appear to be to provide the very highest accuracy and the most enduring materials and surfaces where they are essential, but to employ lower standards of accuracy and materials in other situations. There is, of course, nothing new in this principle itself, but its association with the design of mechanisms is not always easy and is therefore passed over, particularly in the kind of cases adumbrated in Prof. Tuplin's question. The "expectation of life" (or endurance) is a factor that should enter into design.

O. B.

London, September 3rd.

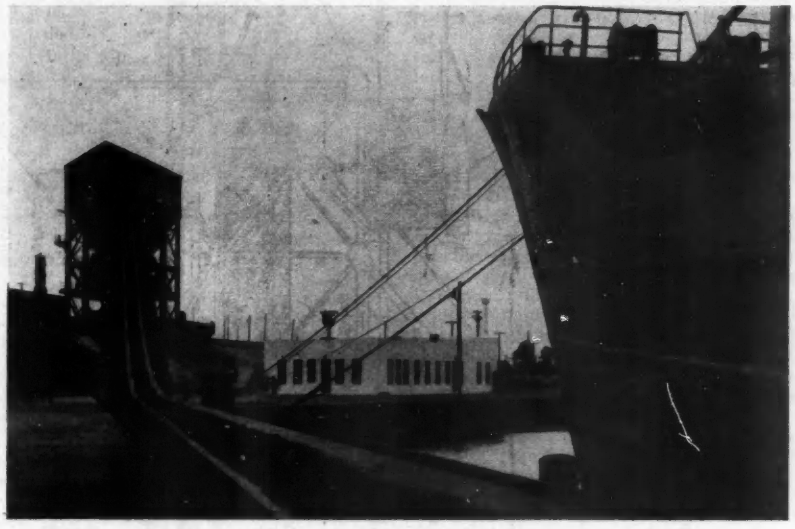
THE INTERNATIONAL MACHINE TOOL EXHIBITION IN LONDON.—A trilingual leaflet is to be widely distributed amongst Continental machine tool makers and users by the Machine Tool Trades' Association, drawing attention to the International Machine Tool Exhibition, to be held in London next year. This exhibition will be held at Olympia from September 17 to October 4, 1952, and those interested will be sent a catalogue upon application to the General Manager, Machine Tool Trades' Association, Victoria House, London, W.C.1.

An Ore Unloading Plant at Baltimore, Maryland

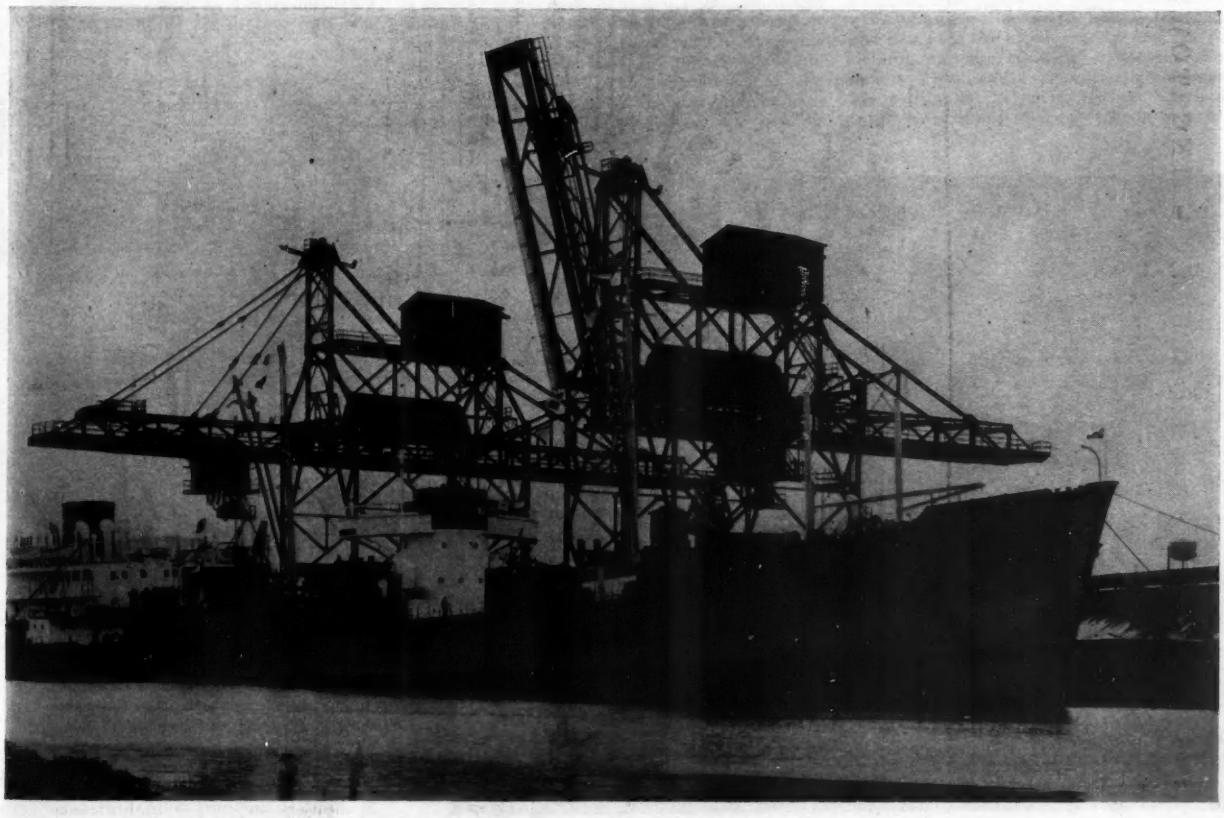
THE growing rate of depletion of the higher grade iron ores of the Mesabi Range in the State of Minnesota has led to the development of iron ore deposits in Labrador, Venezuela, Chile, Liberia and other countries. Thus, while until recently the problem of handling the ore was one concerning only the Great Lakes fleets and their ports, it has now become a question of world-wide ore-carrier and American coastal port facilities. Realising the need for increased docking facilities for ore carriers on the eastern seaboard of the United States, the Baltimore and Ohio Railroad Company decided early in 1950 to construct a large import pier at Curtis Bay in the Port of Baltimore. The Baltimore and Ohio Railroad has a particular interest in iron ore transport facilities as it serves most of the major iron and steel-making centres of the Eastern United States as well as the ports of New York, Philadelphia, Wilmington and Baltimore. The site chosen at Curtis Bay is particularly favourable for the new pier as it is immediately adjacent to the railway company's coal pier, where the loading out of coal for water transportation makes available empty railway wagons, which can be loaded with ore. Thus, the wagons can to a considerable extent be utilised in a two-way movement, whereas up to the present time they had been employed largely in a one-way movement only. The pier has a handling capacity of 10,000,000 tons of ore per year. It can accommodate vessels of up to 40,000 tons and has facilities allowing the unloading of a 30,000-ton ore carrier within twenty-four hours. Of particular interest, from an engineering point of view, are the ore unloading and handling facilities of the pier, which will be discussed in detail below.

The pier itself is of along-shore design with a single water side. It consists essentially of two parallel reinforced concrete dock walls which support the unloader tracks on 65ft centres, and are carried on cast-in-place concrete piles. Along the docking side of the pier a steel sheet piling facing is provided. The two dock walls are tied together by 2in diameter rods on 6ft centres, and the space between the walls is filled with granulated slag. In its initial phase the resulting dock is 650ft long by 80ft wide. Mounted on and travelling along the length of the pier are two steel unloading towers which transfer the ore from the ocean-going vessels to a single belt conveyor running along the dock, parallel to the vessel and beneath the unloaders. The conveyor delivers the ore into a discharge bin situated over the loading tracks of the railway yard. From the discharge bin the ore is fed to scale hoppers, is automatically weighed, and is discharged to railway wagons which are shunted into position by an engine.

Initially, certain fundamental requirements were established for the design of the equipment. By its very nature as a common carrier dock, the pier will be required to handle whatever materials may be offered to it and to unload from whatever vessel in which this material may be carried. It was thus impossible to define accurately the weights and gradations of ores which might be encountered and the limitations in hatch sizes through which these ores might have to be moved. Accordingly, the minimum cubic and resulting tonnage capacities were based upon ore weighing 150 lb per cubic

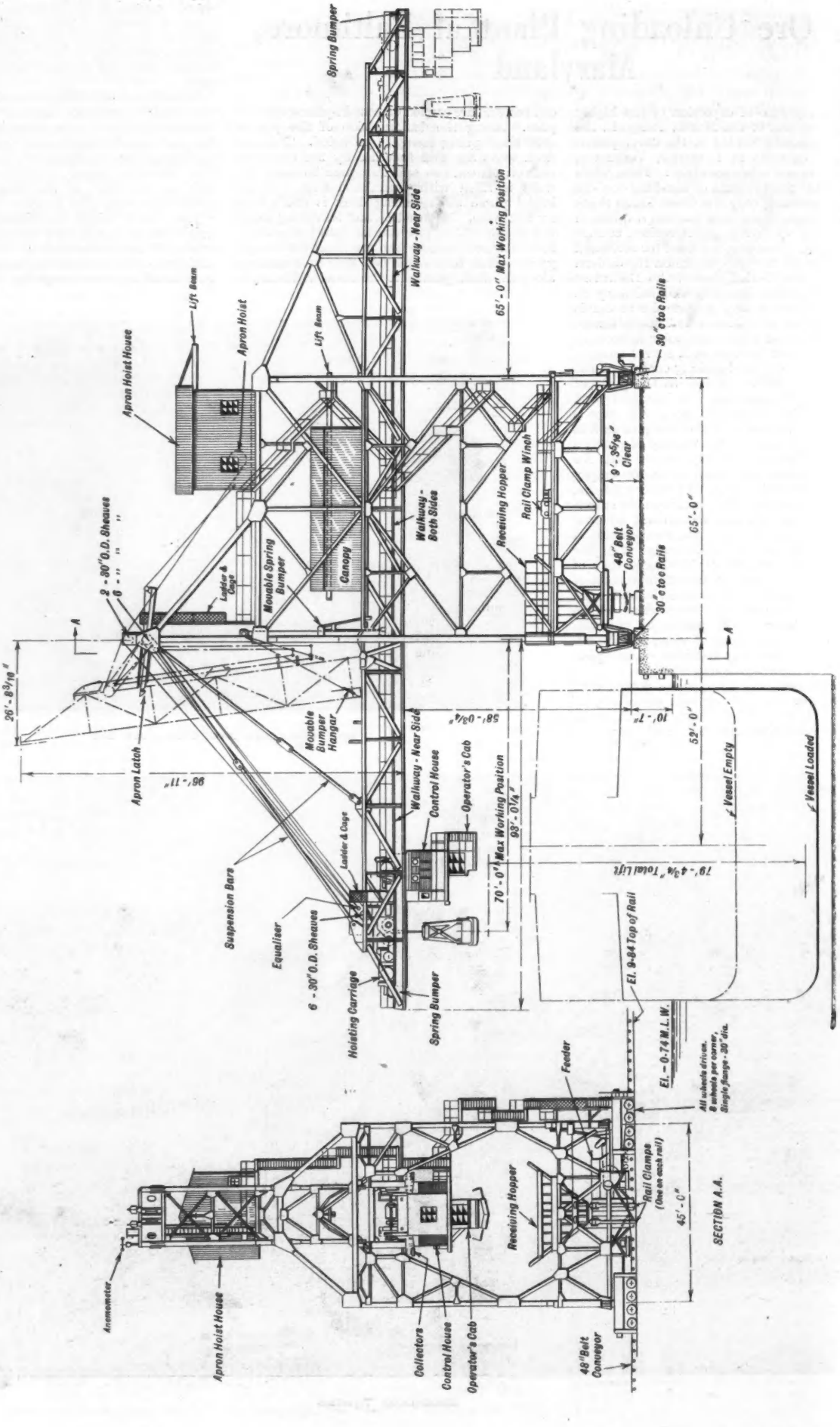


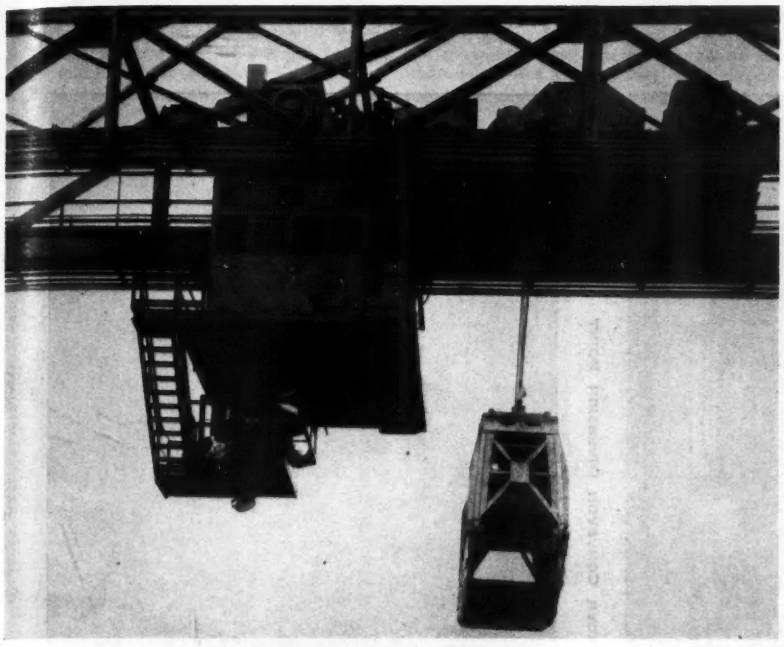
BELT CONVEYOR AND DISCHARGE BIN



UNLOADING TOWERS

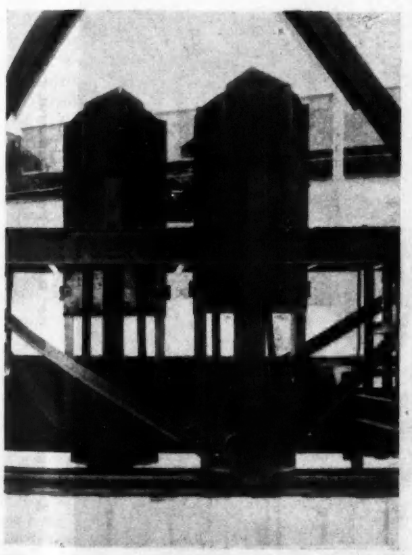
ORE UNLOADING TOWERS AT BALTIMORE, MARYLAND





HOISTING CARRIAGE AND BUCKET

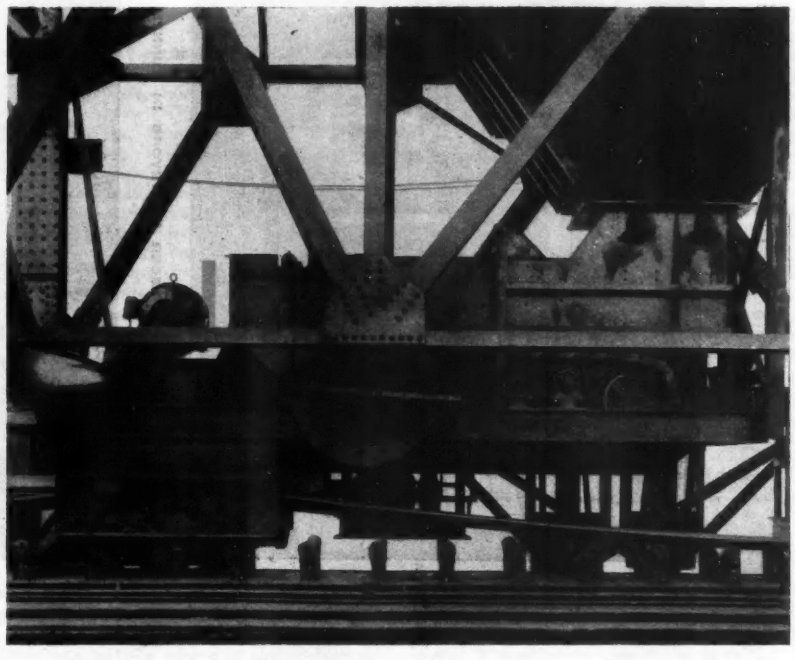
foot, but all mechanical, structural and electrical parts were designed to handle equivalent sizes of ores weighing 200 lb per cubic foot. The equipment was designed to accept ores ranging from granular to 24in lumps as far as gate and chute sizes, feeders and hoppers were concerned, but it was ultimately decided to screen out the larger lumps, should they be encountered, and a bar screen having 15in square openings was provided above each unloader feeder hopper. The problem of ship hatches was met by providing buckets of varying size having capacities of 200 cubic feet, 120 cubic feet and 60 cubic feet, respectively. The largest bucket has a nominal rated capacity of 15 net tons when handling 150 lb ore or 20 net tons when handling 200 lb ore, and was intended primarily for the rapid emptying of the more modern vessels having a favourable size of hatch. The smaller buckets are of the digging type and are intended to be used for the unloading of the smaller tramp vessels with restricted hatches. These buckets are arranged to rotate in a horizontal plane to facilitate entry into small hatches or to excavate where unusual space restrictions exist.



TOWER BASE RAIL CLAMPS

The two unloaders are identical, and each unit consists of a travelling structural tower having a span of 65ft and a distance between centres of legs along runway rails of 45ft. The tower supports a horizontal runway which provides for an overall hoisting carriage travel of 200ft. This travel is made up of a front cantilever providing for a working travel of 70ft from the front legs of the tower, a fixed runway through the tower of 65ft length, and a rear cantilever providing rear working travel of 65ft. The front cantilever is in the form of a hinged apron which can be raised to clear ships' rigging when a vessel is being moved into position alongside the pier, or when the unloader is being moved along the pier from one hatch to another. When in the fully raised position the apron is automatically latched. However, engagement with the latch is generally not made unless the unloader is to be maintained idle for a considerable period. Ordinary movements of the unloader along the dock are usually made with the apron raised sufficiently to clear any possible interference. In the lowered position, the apron is suspended from structural eyebar members which carry all the dead load and live load, while the lifting ropes are allowed to become slack. The raising of the apron is accomplished by means of a single drum, direct-connected electric hoist situated in the apron hoist house at the top of the tower. Raising the apron requires four minutes. The apron hoist drum is driven by a 65 h.p. motor through worm and spur gear reductions. The welded hoist drum has a 50in pitch diameter and is 8ft 10½in long. The reeving consists of two ¾in diameter ropes, with each rope having one end connected to the hoist drum, reeved seven parts over 30in diameter sheaves, and with the other end connected to an equaliser at the outer end of the apron. The rear cantilever is fixed in position and serves an area which may be utilised for the temporary storage of ore in the event of it necessary to unload vessels at a time when railway wagons may not be available. At the outer end of both the hinged apron and the rear cantilever there is provided a terminal buffer, which is arranged to engage the hoisting carriage. It consists of coil springs and has a spring capacity to absorb the full energy of the carriage without the bucket when travelling at 50 per cent of the balanced carriage speed. A similarly constructed buffer of lesser capacity is arranged to be automatically lowered into position at the outer end of the fixed runway in the tower as the apron is raised, in order to provide safety for the limited carriage movements which may be made with the apron in the raised position.

The hoisting carriage comprises two hoist motors of 250 h.p. continuous capacity and two traversing motors having a 125 h.p. one-hour rating. The hoisting speed is 250ft per minute, and the balanced rate of cross traverse is 1000ft per minute. When handling 15 tons of ore in the 200 cubic feet bucket the operating weight of the carriage is 112 tons. With the above motors and speeds the unloader is able to operate on an average free digging cycle of forty-five seconds from ship's hold to unloader hopper, and under free digging conditions is capable of transporting 150 lb ore at a rate of 1200 net tons per hour. The bucket hoist consists of two parallel welded drums of 34in pitch diameter, mounted across the carriage, one being for the closing motor and one for the holding motor. Hoisting is accomplished by means of both motors operating simultaneously. Each drum is driven by its respective motor through a double-helical motor pinion and



ORE HOPPER, GATE AND FEEDER

CONVEYOR SYSTEM OF A MOTOR CAR ASSEMBLY PLANT

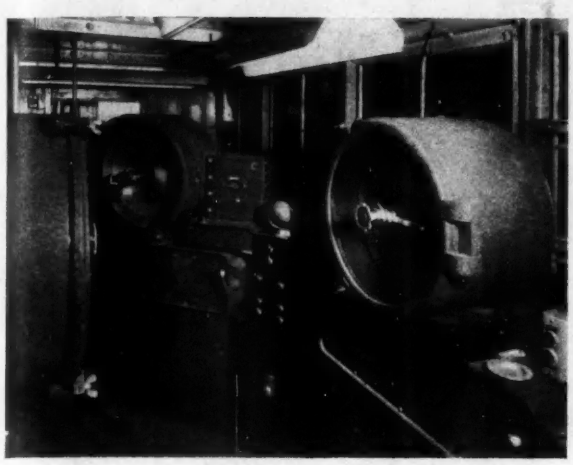
FEEDER CONVEYOR DIVERSION POINT

CHASSIS ASSEMBLY LINE

FEEDER CONVEYORS IN TUNNEL

STORES GROUPING OF PARTS FOR ASSEMBLY LINE

gear and a spur drum pinion and gear. The carriage is spring mounted on four 33in diameter tapered tread, single-flanged, wrought steel wheels. Each axle is driven by a single motor through a double-helical set of gears. There is mounted on the carriage deck a turntable for rotating the smaller buckets, which consists of a cast turntable ring equipped with vertical and horizontal rollers and provided with a bevel rack for driving. Rotation is accomplished by a 6½ h.p. motor producing a turning speed of 9 r.p.m. In order to facilitate the changing from one bucket to another, attachment to the turntable ring is made by means of wedge rope sockets, and each bucket is provided with its own separate set of ropes, which stays with it at all times.



ORE HOPPER SCALES

The operating weight of the entire tower is 685 tons, and each corner is carried upon eight 30in diameter, single-flanged, wrought steel wheels arranged to travel on track rails spaced 2ft 6in apart. All eight wheels on each corner are driven by a 33 h.p. motor through worm gearing connected by universal joints and flexible couplings. Four rail clamps are provided for each tower, and these are sufficient to hold the tower against a wind pressure of 40 lb per square foot. Clamping is obtained by the action of heavy helical springs acting against a toggle to spread the upper ends of the clamp arms. Release is effected by pulling the arms together by a winch-operated rope system. Under normal operating conditions power is not available for moving the tower until the clamps are released, and, on the other hand, clamp setting is delayed until the brakes have brought the tower to rest. The clamps may be set in case of an emergency by the operator, as a result of power failure, or as a result of operation of the tower anemometer which cuts off the power at a predetermined wind velocity, applies the brakes and sets the clamps.

Situated beneath each unloader is a heavy-duty manganese steel feeder above which is a 160-ton surge hopper arranged to deliver ore to the feeder. Regulation of ore flow is accomplished by means of a ratchet-operated regulating gate which, when set, determines the depth of ore on the feeder. The feeder itself is powered by a 15 h.p. variable-speed motor and the rate of feed to the belt may be varied from 665 tons per hour to 1330 tons per hour when handling 150 lb ore. As part of the hopper and feeder unit, there is provided a system of rubber impact idlers mounted on the feeder supports, and arranged to support the main conveyor belt at any loading point so as to support and cushion the belt during loading. A special arrangement of chutes, skirts and fingers permits the finer material to reach the belt in advance of the larger lumps so that these will be delivered to the belt on a moving bed of finer material. The main belt is 48in wide, travels at 400ft per minute, and is able to handle 2000 tons of ore per hour. It is of 9×11 ply construction and has a ¼in top cover and a $\frac{1}{16}$in bottom cover. The belt conveyor has a total length of approximately 895ft, travels horizontally along the dock beneath the two unloaders, rises along a vertical curve of 525ft radius, and ascends at a slope of 16 deg. to deliver ore to the discharge bin. A two-motor belt drive is used, comprising a 200 h.p. primary drive motor and a 100 h.p. secondary drive motor. The drive pulleys are 72in in diameter; the tail pulley is 66in in diameter, the snub pulleys are 36in in diameter, and the take-up pulley is 48in in diameter. A vertical counter-weighted belt take-up is employed, situated midway along the inclined portion of the conveyor. The belt idlers are 6in rollers spaced at 3ft centres along the slope and the vertical curve, and at 2ft 6in centres along the horizontal portion. The primary drive for the conveyor is situated in the motor room above the discharge bin.

The main conveyor discharges ore into a 500-ton steel hopper, below which are placed four heavy manganese steel apron feeders identical with those used underneath the unloaders, except that at the discharge bin the feeders are powered by 15 h.p. single-speed motors. Each feeder transfers ore from the discharge bin to a spring-mounted scale hopper having a maximum capacity of 40 tons of 150 lb ore. Two loading tracks and one shunting track pass underneath the discharge bin structure. The 40-ton scale hoppers are arranged in pairs over each loading track, are each equipped with motor-operated double clam gates and discharge the ore into the railway wagons. The scales are of straight lever design and can be preset to weigh out automatically any required tonnage of ore. They are equipped with dials to show the amount of ore in the scale hoppers and have recording units which are arranged to print both the gross weight and the tare weight on special cards, thus recording the net quantity of ore delivered to the wagon. The scale room is suspended underneath the discharge bin and between the scale hoppers.

Power for operation of the entire handling equipment is 230V d.c. Full magnetic control is used generally throughout, and safety interlocking and limit switch protection is provided. The unloader is controlled from the operator's cab on the hoisting carriage, where are situated the master switches for the hoisting and traversing motions and for the unloader tower travel as well as means for the control of the unloader feeders. Control of the apron hoist is provided at the apron hoist house and also at the carriage runway level on the tower. The apron control is interlocked with the carriage position so that the apron may not be raised unless the carriage is clear of the apron and also clear of the descending movable buffer. The main conveyor may be stopped and started from the conveyor motor house and from the scale house below, while the unloader feeders may be stopped and started from the operator's cab on the hoisting carriage or from a station on the tower at dock level. The main belt and the unloader feeder are interlocked so that stopping of the main belt will stop the apron feeders, and, on the other hand, these feeders cannot be started unless the main conveyor is running. At the discharge bin, limit switches are provided to prevent the ore from overflowing the bin. The weighing of ore and the operation of the scale hopper gates and the hopper feeders are semi-automatic. The filling of the scale hopper is automatic to the predetermined weight set on the dial by the operator. The feeding of the ore to the scale hoppers is started automatically by the closing of the gates at the bottom of the hopper, and loading of the scale hopper continues until correct weight has been reached, after which the feeder is automatically stopped. Opening of the gates to discharge the ore is performed by push button, and the closing of the gates repeats the cycle.

The Dravo Corporation, of Pittsburgh, Pennsylvania, was responsible for the design, fabrication and erection of the ore unloading and handling plant described in this article.

Conveyor System of a Motor-Car Assembly Plant

IN a new assembly plant laid down at the works of the Austin Motor Company, Ltd., Longbridge, Birmingham, there has been installed an interesting conveyor system for supplying units to the main assembly lines. With this system, which combines storage with mechanical handling, the transfer of bodies, power units and axle units from the sub-assembly departments to the main assembly lines in the new building is synchronised by switchgear controlled by punched cards. The conveyors feeding the units to the main assembly lines move up automatically as a component is removed, and the parts are fed in their correct order as assembly of a vehicle proceeds. All these movements of the conveyors and transfer equipment are predetermined and automatically controlled. With the new handling and storage equipment, and the control system it incorporates, manual handling of units has been almost eliminated, and it is now possible to keep to a minimum the stocks of parts and sub-assemblies which have to be held.

The new plant makes extensive use of the "Dual Duty" conveyors developed by Geo. W. King, Ltd., of Hitchin, Herts, the design of which combines a means of storage with a system of by-passing and sequencing with switchgear to the pattern preset by the punchings in the cards at the control points. This firm also supplied the assembly slat conveyors, elevators, overhead runways and pulley blocks installed in the plant. For punching the cards which actuate the electrical control gear, Hollerith machines supplied by the British Tabulating Machine Company, Ltd., are used.

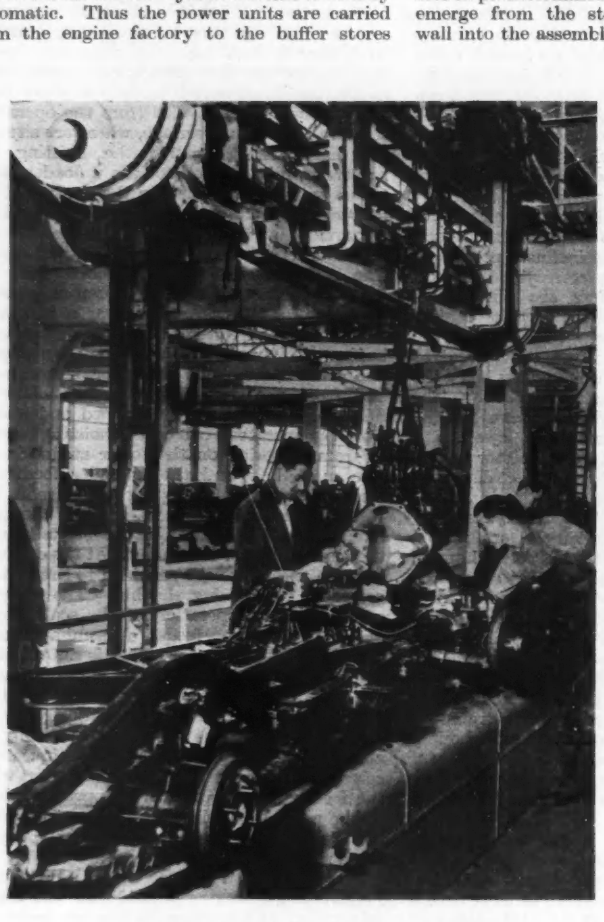
In the photographs reproduced overleaf and on page 310, there are to be seen some of the sections of the storage feeder conveyors and assembly stations in the new plant.

The new building for car assembly is on the top of a hill, and its floor level is approximately 70ft above the level of the other buildings. Advantage has been taken of this difference in levels by bringing the main units for the assembly lines into the building by conveyors running through a tunnel at one side and below floor level, as shown in one of our illustrations on page 310.

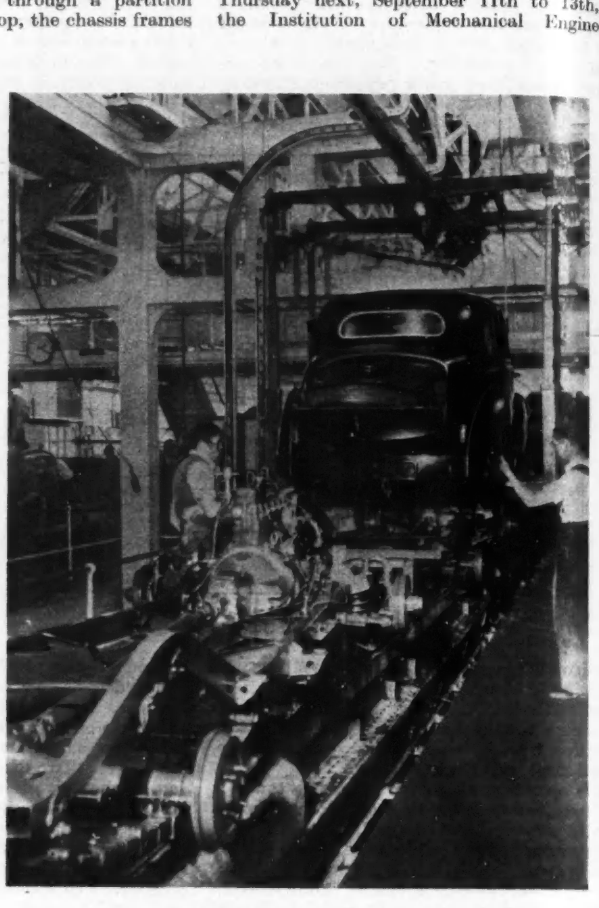
The lay-out of the operations in the older buildings producing parts and units has been rearranged so that the building nearest to the new assembly plant now houses all the equipment for body painting and trimming. A mezzanine floor has been erected in this building to provide accommodation for the storage conveyors for power units and axles. These storage conveyors are "Dual Duty" twin-rail conveyors fitted with indexing units so that when the first trolley with its power unit or axles is taken away and transferred to the feeder conveyor, the others all move up accordingly. The principal reason for installing these storage conveyors is that the hours worked in

the engine and axle shops are different hours from those in the body and car assembly shops, so a buffer stock of units is necessary.

The major units are carried on " Dual Duty " conveyors all through the works, and the transfer from one conveyor to another is entirely automatic. Thus the power units are carried from the engine factory to the buffer stores and from there to the assembly lines without any assistance from the operators. Rear axles and front suspension units are transported in a similar way.



POWER UNIT INSTALLATION STATION



BODY MOUNTING ELEVATOR

The buffer store for power units and axles is built in the roof of the body shop, directly above the ends of the body lines, and the major units all travel together to the new building on three conveyors. The three conveyors for power units, axles and bodies pass upwards through the roof of the body shop, across a bridge into the tunnel, and so into the unit pits below the assembly lines. The issue of these units—that is to say, their automatic transfer from the stores conveyors to the tunnel conveyors—is controlled by the punched card system which ensures that the correct units are issued in the right sequence at the right time. If it is necessary to curtail production for any reason, blank cards are fed through and then empty pusher dogs go up the tunnel conveyors instead of loaded trolleys. The spacing of the pusher dogs on the tunnel conveyors is rather long, in order to reduce the number of units on the conveyors. The length of the tunnel conveyors is such that if the units were carried at close pitch a very large number of them would be on the conveyors.

The tunnel conveyors run into pits directly underneath the assembly lines, where the units are diverted automatically on the feeder conveyors for the appropriate assembly lines above. These feeder conveyors are also fitted with indexing units so that a stock of about three units for each assembly line is held in the pits. At the necessary points the feeder conveyors transfer the units on to the travelling load bars of vertical elevators which take them up to the assembly lines.

There are three main assembly lines, with provision for a fourth when required. Each line starts as a steel slat conveyor with fixtures to carry the cars and all their parts at suitable intervals. These conveyors start in the stores, where all the necessary parts are laid on in sets in predetermined places. As the conveyors emerge from the stores through a partition wall into the assembly shop, the chassis frames are lowered on to fixtures by electric pulley blocks running on overhead monorail runways from the chassis frame stores, and the assembly operations commence.

The chassis frame moves along the conveyor as assembly proceeds, and when it reaches a point directly above the axle pit, the elevator brings up the front suspension units and the rear axle, and lowers them into position automatically. Empty unit slings are taken back to the pit and transferred to the tunnel conveyor on which they are returned to the starting point. The rear axle is lowered through the chassis frame on to a fixture which holds it in a position at right angles to the frame, and when the chassis reaches a certain point in the line the fixture turns automatically to bring the axle to the correct position. A little further along the line another elevator brings the power unit up from the pit and lowers it into its correct position in the chassis frame. These engine slings are self-releasing, and all the operators have to do is insert the engine-fixing bolts and tighten them.

At the end of the chassis assembly conveyor the completed frame is transferred automatically to a " Dual Duty " conveyor which takes it through an electrostatic spray painting booth and a drying oven. The chassis is then transferred to the body mounting conveyor, the elevator of which brings up the appropriate body from the pit below and places it in position. Then after the wheels have been fitted each car is carried on its own wheels on an elevated twin slat conveyor so that the operators can work underneath it without standing in pits. Working platforms are also arranged along this conveyor At the end of the line the twin slat conveyor sinks into floor level so that the car may be started and driven away under its own power.

Discussion on Heat Transfer

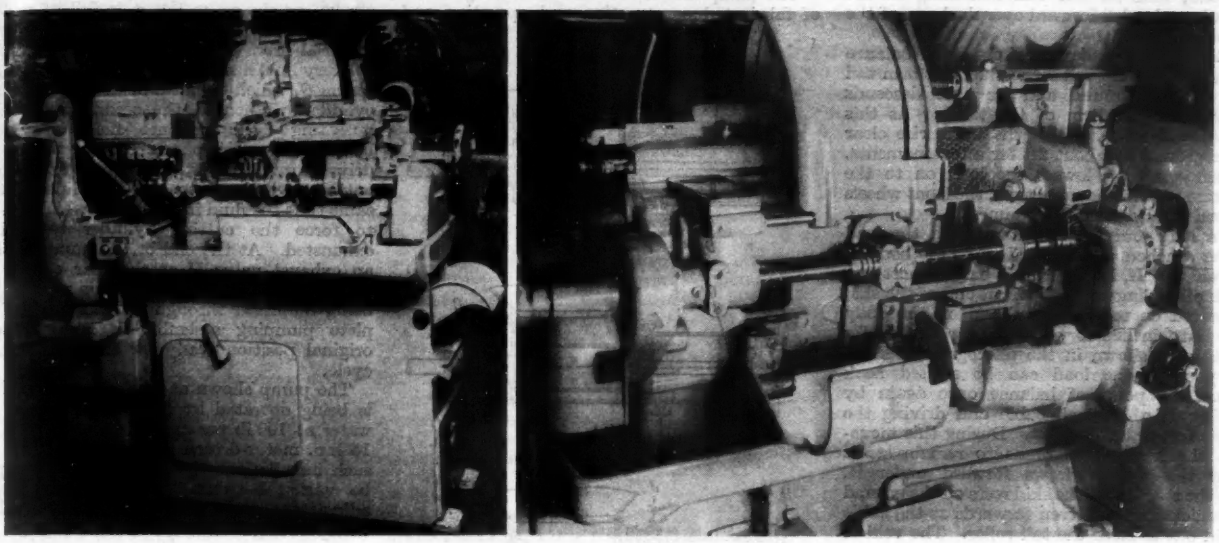
DEVELOPMENTS in the mechanism of transference of heat and in the design of apparatus related thereto are to be discussed at a conference which is to be held from Tuesday to Thursday next, September 11th to 13th, at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. The conference has been arranged jointly by the Institution of Mechanical Engineers and the American Society of Mechanical Engineers. Many other institutions in this country, the British Commonwealth, Europe, Canada and the U.S.A. are taking part in the Conference.

Approximately 100 papers, which will be presented in abstract, are to be discussed at the conference. The scope of the papers has been restricted to developments which have taken place during the last ten years, 1941–1950, and they will be discussed under five main headings, as follows :—Heat transfer with change of state ; heat transfer between fluids and surfaces ; conduction in solids and fluids ; radiation, instrumentation, measurement techniques, and analogies ; special problems such as heat transfer in turbine blade cooling, liquid metals, gas turbines, piston engines, the mercury boiler, &c. The conference will begin at 10 a.m. on Tuesday, September 11th, and there will be morning and afternoon sessions on each of the three days. A buffet luncheon will be available each day, for registered members of the conference, at Caxton Hall, Caxton Street, London, S.W.1.

On Tuesday evening, September 11th, in connection with the conference, there is to be a reception and conversazione at the Institution of Mechanical Engineers, beginning at 8 p.m. On Wednesday evening, September 12th, at 8.30 p.m., also at the Institution of Mechanical Engineers, a James Clayton Lecture will be delivered by Professor A. P. Colburn, of the University of Delaware, on " Problems in Design and Research on Condensers of Vapours and Vapour Mixtures." On Thursday evening, September 13th, there is to be a dinner at St. Ermin's Hotel, Caxton Street, S.W.1

A Simplified Single-Spindle Automatic

A SIMPLIFIED design of single-spindle automatic now being made by B.S.A. Tools, Ltd., Mackadown Lane, Marston Green, Birmingham, has provision for only one tool in addition to those on the cross slides. The firm decided to introduce this machine because of the present heavy demand for machine tools and the fact that many components are made which do not require a multiple operation machine. By producing such parts on a simple, less expensive machine which retains the accuracy and speed of the standard range of B.S.A. single-spindle automatics, material and time can be conserved and a greater number of six-station automatics made available for more complicated components.



A SIMPLIFIED SINGLE-SPINDLE AUTOMATIC

Two sizes of the new machine are at present available, one with a bar capacity up to ½in diameter and the other for bars ¾in diameter. The basic construction of these simplified machines is similar to that of the firm's other single-spindle automatic screw machines, but in a number of respects the design has been altered. As already mentioned, provision is made for one tool in addition to those on the cross slides, and an extended feed of bar stock permits the production of parts considerably longer than those usually accommodated on automatics.

In these new machines drive from a self-contained motor mounted at the rear of the base of the machine is transmitted through vee ropes to the main gearbox shaft. A range of ten forward spindle speeds from 474 to 4480 r.p.m. can be obtained on the larger machine and twelve, from 1005 to 6020 r.p.m., on the smaller machine by changing one pair of gears.

The plain work spindle is mounted on roller bearings and toggle-operated collets are provided. The spindle is driven through a single sprocket and a chain from the gearbox, correct chain tension being maintained by an adjustable jockey sprocket in the machine base.

The front camshaft, which can clearly be seen in one of the illustrations on this page, controls the cross slides, stock feed, work chute, collet opening and closing. This camshaft is driven by the lead camshaft from the backshaft through a worm drive and pick-off gears which provide sixty-five different cycle times in the larger and forty-six in the smaller machine quite independently of the spindle speeds. Changing over from one cycle time to another is effected simply and rapidly by pick-off gears at the end of the machine.

The backshaft is driven at a constant speed by a belt connected with the main drive shaft, and it can be engaged or disengaged through a lever-operated clutch. A handwheel is provided for manual operation of the machine for the purpose of setting up, &c. Dog clutches to control stock feeding and collet opening or closing cams are mounted on the backshaft, and they are operated by adjustable trips on the front camshaft.

The cross slides are operated by disc cams mounted on the front camshaft, and a third or vertical slide, which can be fitted when required, is controlled by an additional cam. Provision is made for the independent setting of each slide either forwards or backwards in relation to the centre line of the spindle. These cross slides have a movement of 1in in the small machine and 1¼in in the large machine.

The conventional indexing turret is replaced by a plain slide carrying one tool holder, which will accommodate any standard turret tool. When only two tools are necessary for machining a component they are carried on the cross slides, and the tailstock slide can then be used as a simple bar stop, or alternatively, if the components being produced are very long, a combined revolving steady and stop can be fitted. Feed is actuated by a cam-operated quadrant and rack. In order that components of various lengths can be machined, the tool holder is adjustable forwards or backwards in relation to the slide to simplify tool setting and reduce time delay.

All headstock bearings and cross slides are automatically lubricated from a plunger pump which draws clean oil from a tank mounted at the top of the base casting, and the chain and gearbox are lubricated by a gear pump, whilst all other bearings are lubricated by grease gun. Filtered coolant is pumped at a constant pressure through a delivery pipe having a nozzle which can be swivelled so that the flow of fluid can be directed on to the tool tip. The separation of swarf and work is effected by the work chute, which is operated from an adjustable dog on the camshaft.

A slipping clutch in the cycle time gear train is designed to operate and instantly stop all moving parts other than the spindle if the machine is subjected to undue strain. Instantaneous stopping is similarly effected by a device in the bar feed mechanism when the remaining bar stock is insufficient to complete another component.

Self-Loading Oilfield Trucks

WE reproduce below a photograph of one of a number of "Mighty Antar" 25-ton oilfield trucks, recently completed for the Shell Petroleum Company, Ltd., by Transport Equipment (Thornycroft), Ltd., of Smith Square, London, S.W.1. The design and construction of this very heavy tractor was described in our issues of April, 28, May 5, 12 and 19, 1951. The new vehicle is equipped with an all-steel platform body supplied by R. A. Dyson and Son, Ltd., and it incorporates a powerful winch and a rear roller for the self-loading of heavy equipment without the assistance of independent lifting plant. The chassis follows the standard design, but it has rear bogie beams in place of rear springs, and the winch is installed at the rear of the driver's cab.

As can be seen in the illustration, the load is

TRUCK WITH LOAD IN TRAVELLING POSITION

carried on an independent skid platform. In the loading operation the vehicle is backed up into line with the end of the load platform and the winch cable is attached to the forward end of the load. The platform is then either drawn towards the tail of the vehicle or, alternatively, the vehicle is reversed up to the load. When the point of attachment of the cable is vertically beneath the tail roller it raises the forward end of the skid until it contacts the roller. The bottom surfaces of the skid "runners" and the load, with its rear end remaining on the ground, are hauled forward over the body of the vehicle.

After the load has reached a state of balance on the axis of the roller the skid platform tail rises off the ground and its nose descends towards the platform of the truck. At this point the front wheels of the truck rise clear of the ground by about 2ft for a few moments. Further winching lowers the load on to the platform and, at the same time, the front wheels descend gently on to the ground.

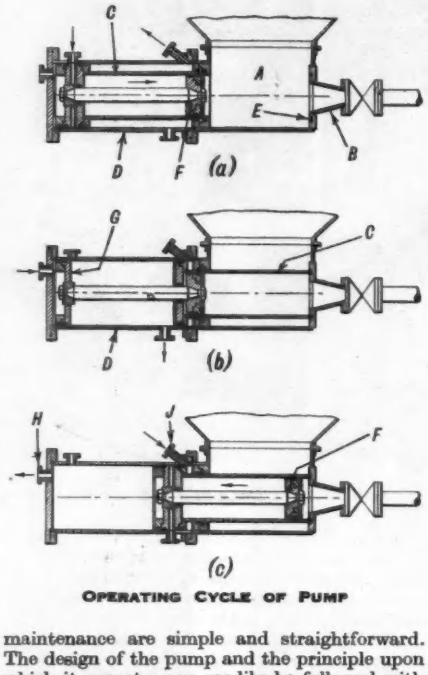
If a long journey is contemplated the load can be winched well forward on to the body of the vehicle. If, however, it is only a short trip to the offloading point the front end of the skid is lowered on to a roller placed on the body floor and winched forward just far enough for stability, as shown in the photograph. From this position the load can be shifted back beyond the point of balance once again by slacking off the winch cable and driving the vehicle forward a few feet. During this movement the heavy load tends to remain static whilst the vehicle draws forward under it. Once the rear end of the skid rests on the ground the vehicle can be driven forwards as the cable is paid out to clear the tail roller. The vehicle is then halted whilst the load is lowered to the ground. Throughout the whole operation of loading and unloading, the load is under the control of the driver of the vehicle at every stage.

We are informed by the makers that two of the vehicles fitted with this self-loading equipment are being shipped to Sarawak and one to Venezuela.

A Pump for Thick Sludges and Clay

A NEW pump for handling difficult materials with a low moisture content, such as thick mud, clays, sewage and heavy residues from manufacturing processes, has been developed by Mr. C. W. Meader and is now being manufactured by Henry Balfour and Co., Ltd., of Leven, Fife. The photograph reproduced on this page shows a pump being fed by hand with a heavy bauxite residue of 30 to 40 per cent water content in the course of a demonstration. This thick process residue was discharged by the pump through a 5in bore pipe-line, 200ft long, and incorporating five right-angle bends. The pump demonstrated was operated by hydraulic power, but the design is such that units can be easily adapted for steam or compressed air or direct mechanical drive.

The pump and its automatic valve gear are of fabricated construction and operation and maintenance are simple and straightforward. The design of the pump and the principle upon which it operates can readily be followed with reference to the diagrams below.



OPERATING CYCLE OF PUMP

Material to be pumped is deposited in any convenient way into a hopper feeding directly down into an open top cylindrical chamber *A*. At the left-hand end of this chamber is a discharge orifice *B*, through which material is pumped into the pipe-line through an automatic non-return valve. At the opposite end of the chamber is the main pumping unit, which incorporates two concentric cylinders. The inner cylinder *C*, known as the cutting cylinder, slides in the main hydraulic cylinder *D*.

At the beginning of the pumping cycle the units of the pump assembly are in the positions shown at (*a*) in the diagram and the chamber is full of the material being handled. Pressure fluid is admitted to the rear of the piston forming the back of the cutting cylinder, which is driven forwards through the material in the chamber. Thus, when the front end of the cylinder registers on an annular seating *E* at the far end of the chamber at the end of its stroke, as shown at (*b*), it is full of material. The rod of the piston *F*, which ejects the material from the cutting cylinder into the delivery line, has its rear end coupled to a main piston *G*, which operates in the main hydraulic cylinder. When in the second stage in the operating cycle pressure fluid is admitted behind the main piston *G*, the piston *F* is driven forward to expel the material from the cutting cylinder into the pipe-line. At the same time the fluid in front of *G* which was used to force the cutting cylinder forwards, is exhausted. At the end of the pumping stroke an exhaust valve *H* at the rear of the main hydraulic cylinder opens and, on pressure fluid being admitted through the port *J*, the complete pumping assembly is restored to its original position ready for the next pumping cycle.

The pump shown at work in our illustration is being operated by hydraulic pressure using water at 100 lb per square inch, supplied by a 15 h.p. motor-driven centrifugal pump. With such installations the speed of the pump can be varied between zero and maximum by adjustment of the pressure at the inlet valve of the operating fluid.

SLUDGE PUMP BEING FED WITH BAUXITE RESIDUE

A 12 Cubic Yard Scraper

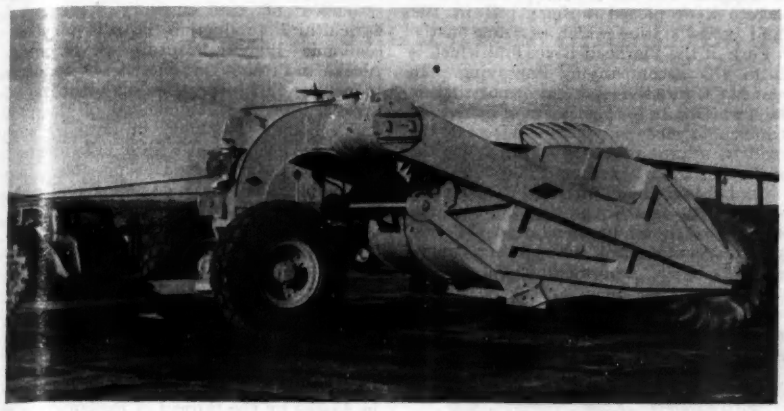
WE have received particulars of a new scraper with a capacity of 12 cubic yards struck and 15 cubic yards heaped, which is now being made at the Rochester works of Blaw Knox, Ltd., of 90–94, Brompton Road, London, S.W.3. This machine, to be seen in the illustration opposite, is similar in most respects to the unit supplied with the firm's self-propelled scraper, which was described in our issue of March 31, 1950. It is 32ft. long, 11ft 8in wide, and 9ft 7in high overall, and it has a wheelbase of just under 18ft 9in

The new scraper is built up of fabricated members and, despite its rigid construction and large capacity, the designers have kept the weight down to a little over 9 tons. The rigid front axle is pivotally mounted on the box section swan neck of a heavy tubular yoke, and a full front wheel clearance gives the machine a small turning radius. Weight is well distributed between the front and rear wheels and, with a clearance of 17in at the front and 19in at the rear of the bowl, the machine has a good degree of mobility over rough ground and wear on the underside of the bowl is reduced. The wheels run on taper roller bearings and the use of divided wheel rims facilitates tyre removal and replacement.

The machine is twin-cable operated and by enclosing the cables and their sheaves in the yoke members a good measure of protection is afforded against the effects of abrasive dust and mud on working sites.

A reinforced double skin is fitted to the bottom of the fabricated mild steel bowl, which has a floor 8ft 9in by 3ft 5in with sides 5ft 2in high. The bowl is raised and lowered through cables at each side, an arrangement which gives the operator an unobstructed view of the cutting edge and bowl interior at all times. A reversible three-piece blade, 8ft 9in long, is fitted to the bowl, and the curved apron of the bowl has a 6ft opening. This apron is operated by a single cable, which is linked with the tailgate cable system; the apron is automatically opened before forward movement of the tailgate begins, and it is closed when the tailgate is fully retracted.

The 4ft 9in high tailgate is operated through cables by a positive ejection arm, which is



12 CUBIC YARD SCRAPER

arranged to thrust centrally on the rear of the gate, the maximum power being exerted when the gate is in its rearmost position where the load is greatest. A spring used for returning the tailgate to its position at the rear of the bowl is enclosed in the bowl tube. This tailgate spring operates through a cable passing over a fusee drum, the cable being anchored at one end on the tailgate and at the other behind the return spring. The fusee drum serves to equalise the spring pressure at all positions of the tailgate in the bowl. Close-fitting scrapers are fitted to the tailgate rollers to keep their runners clear of dirt, and all the sheaves are mounted on protected roller bearings to ensure free running of the cables. The bowl tube, which is fitted with a block for rear pushing purposes, is reinforced with a rigid fabricated frame. The height of this pusher block and the positioning of the thrust tube ensures that the full pusher tractor effort is transmitted direct to the cutting edge of the bowl.

An Improved Compressed Air System

THERE has recently been put into production by the Hymatic Engineering Company, Ltd., of Redditch, a development of the compressed air equipment, illustrated in our photographs, which is to be fitted to a series of engines produced by H. Widdop and Co., Ltd., of Keighley. The new system results in a reduction of the amount of compressed air used for each starting operation, and is based on the use of a relay-operated injector valve and a small distributor, which gives a simplified piping run for the main air starting line. The simple arrangement of the large-diameter piping effects savings in the cost of the pipe and also in manipulation costs, while the small-diameter relay pipes are easily formed and can be neatly placed between the distributor and the injector valves.

An air relay operated by a pulse of air from the distributor forms the injector valve, with the air relay in the valve connecting the main trunk line to the cylinder and so providing the turning force. At a predetermined point on the piston stroke the distributor cuts off the air to the relay, which closes the injector valves and then the compressed air in the cylinder is normally exhausted. The distributor supplies relay air control to the injector valves to give a smooth and continuous starting effort. The remainder of the equipment in the system consists of an air compressor, storage bottle and master stopcock.

American Engineering News

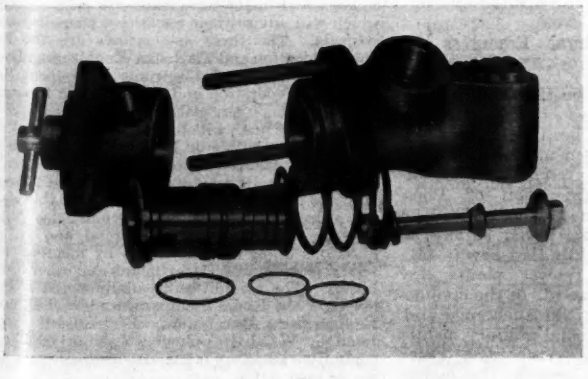
(From our American Correspondent)

A Symposium on Low-Temperature Physics

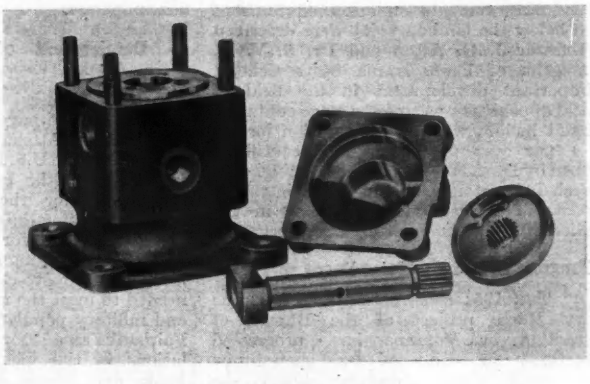
More than 200 American and foreign physicists attended a Symposium on Low-Temperature Physics, held at the National Bureau of Standards in Washington recently. Sponsored by the Bureau in co-operation with the Office of Naval Research, the meeting was under the joint chairmanship of Dr. Emanuel Maxwell and Dr. John R. Pellam, of the N.B.S. low-temperature laboratory. While the subject of superconductivity—the loss of electrical resistance at very low temperatures—and the properties of liquid helium II received major emphasis at the conference, a wide variety of other topics was covered, including low-temperature magnetism, calorimetry, chemical physics, and the design of low-temperature equipment.

The first day of the conference was devoted to superconductivity and the isotope effect, which relates superconductivity to the atomic mass, was the topic of much of the discussion. The recent discovery of this phenomenon at the National Bureau of Standards, in combination with independent results obtained almost simultaneously at Rutgers University, revealed the role of lattice vibrations in superconductivity, providing a basic concept for current theories. Results of superconductivity measurements on isotopes at Oxford, Cambridge and Rutgers Universities and the Bureau were presented, compared, and discussed. One of the highlights of the first day was a panel discussion on the theory of superconductivity, which was conducted by Dr. J. Bardeen, of the Bell Telephone Laboratories, Professor H. Frohlich, of the University of Liverpool, and Professor L. Tisza, of the Massachusetts Institute of Technology, exponents of the more important theories contending for recognition to-day. All three theories incorporate the concept of interaction between lattice vibrations and electrons as a fundamental building block. It was agreed that although superconductivity theory is still in a rudimentary stage, the recognition of the importance of lattice vibrations is a significant advance. Other interesting topics in superconductivity included the superconducting properties of thin films and alloys, thermal conductivity, specific heats, high-frequency behaviour of superconductors, and the discovery of new superconductors. The demonstration of a substantially complete Meissner effect in single-phase alloy systems, reported by Professor J. V. Stout and Professor L. Guttman, of the Institute for the Study of Metals, University of Chicago, was of considerable interest. Dr. D. Shoenberg, of the Mond Laboratory, in a discussion of recent work on superconductivity at Cambridge University, reported the discovery that the elements osmium and ruthenium are superconducting. Since these elements are transition metals, the discovery of their superconducting properties disproves the previously suggested theory that superconductivity is a property of only two groups of elements in the periodic table. Another report from the Mond Laboratory dealt with the work of Faber on supercooling effects and the growth of superconducting nuclei in superconductors. Results on the anomalous heat conduction of some superconducting alloys were presented by Professor K. Mendelssohn, of Oxford University, and by Dr. J. K. Hulm, of the Institute for the Study of Metals, University of Chicago. Professor Mendelssohn suggested that the results imply a circulation process in superconductors like that occurring in helium II, but there was no general agreement on this point. Professor R. Hilsch, of the University of Erlangen, described experiments on superconducting thin films in which it was possible to control the transition temperature over wide limits by varying the experimental conditions during deposition.

The second day of the symposium was spent on the properties of liquid helium II. The session began with a group of papers on liquid mixtures of He^3 and He^4. Professor J. Daunt and Dr. C. V. Heer, of Ohio State University, reviewed measurements of the depression of lambda temperatures in solutions containing up to 89 per cent of He^3. Transition temperatures as low as 0·2 deg. K in the presence of He^3 were described, and agreement was shown with theory based on London's Bose-Einstein hypothesis. The phase diagram for dilute solutions of He^3 and He^4 was reported by Dr. H. S. Somers, of the Los Alamos Scientific Laboratory, and a theoretical interpretation was given by Dr. W. Goad, of Los Alamos, also on the basis of a London statistical model



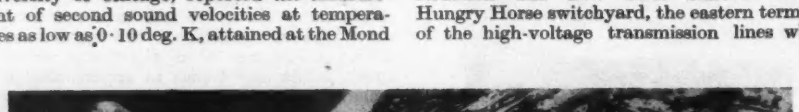
AIR INJECTOR VALVE COMPONENTS



AIR DISTRIBUTOR DETAILS

Of special interest was the announcement by Drs. D. W. Osborne, B. M. Abraham, and B. Weinstock, of the Argonne National Laboratory, that they had succeeded in solidifying He^3. Their results indicate that He^3, like He^4, probably does not have a triple point and that the liquid is the stable condensed phase at absolute zero. Interesting experimental developments were discussed in the field of "second sound," a wavelike method of heat transfer occurring only in helium II. Dr. D. V. Osborne, of the Institute for the Study of Metals, University of Chicago, reported the measurement of second sound velocities at temperatures as low as 0·10 deg. K, attained at the Mond Laboratory by means of adiabatic demagnetisation. This work verified the results of an earlier experiment of the same kind at the National Bureau of Standards, which showed that the velocity of second sound increases drastically below 1 deg. K. The more recent experiments, however, have been carried to much lower temperatures and the velocity of second sound has been found to approach about $1/\sqrt{3}$ that of the estimated velocity of ordinary sound at these temperatures.

Several papers dealt with superfluid flow in helium II and the helium II film. Mr. J. E. Robinson, of Duke University, presented a theoretical paper, in which he suggested that the entropy of helium II might be measured mechanically by means of adiabatic oscillations in communicating vessels. Super-flow experiments, described by Professor K. Mendelssohn, of the Clarendon Laboratory, show new effects, which indicate "that a determination of pressure in super-flow requires additional knowledge to the definition of this quantity under classical conditions." Dr. D. C. Henshaw and Dr. L. C. Jackson, of the University of Bristol, described thickness measurements of the stationary helium II film on solids by an optical method, which has now been extended to permit measurements as much as 7cm above the liquid helium surface. Dr. J. G. Dash and Professor H. A. Boorse, of Columbia University, reported film-thickness measurements by means of a capacitor depth gauge operated at radio frequencies. Heat-capacity measurements on adsorbed films of helium below the lambda point were described by Professor J. G. Aston and Dr. S. V. R. Mastrangelo, of Pennsylvania State College. An important development in the field of practical apparatus was a new storage container for liquid helium with an evaporation loss of only 1 per cent per day. This container, described by Dr. A. Wexler, of the Westinghouse Research Laboratories, should go far in relieving some of the technical problems in the operation of a low-temperature laboratory.



HUNGRY HORSE DAM

Progress at Hungry Horse Dam

THE 1951 construction season at the Hungry Horse project of the Bureau of Reclamation in Montana has progressed satisfactorily in spite of two snowstorms which struck without warning during the month of April. A total of 115,640 cubic yards of concrete were placed during April in the dam and power station which is rising on the South Fork of the Flathead River and which is shown in the accompanying engraving. In accordance with the present construction schedule, which calls for placement of more than 1,200,000 cubic yards of concrete this year, the dam will be approximately 400ft high by the end of the construction season. The completed dam will be 564ft high, making it the third highest concrete dam in the world. The construction has now been started of the Hungry Horse switchyard, the eastern terminus of the high-voltage transmission lines which will link the Hungry Horse power station with other federal, muncipal and private power plants in the Northwest "power pool." Initial work at the 225ft by 165ft switchyard, which is situated approximately 1200ft downstream from the Hungry Horse power station, includes the installation of concrete footings to support nine 68ft high steel towers. Concrete footings are also being placed for the high-voltage oil circuit breakers and a steel service building. Present plans call for the installation of three 230kV oil circuit breakers and disconnecting switches for a 230kV transmission line to be constructed by the Bonneville Power Administration from Hungry Horse dam to Hot Springs. Assistance in keeping construction on the Hungry Horse project on schedule has been extended by the U.S. National Production Authority, which has granted a limited priority to the project. Thus, priority assistance is now available for the purchase of materials and equipment to be incorporated in the dam and the power station. However, priorities can be used only in emergencies where it is impossible to secure critical materials through normal channels. The granting of the priority is considered to be an official recognition of the importance of making available hydro-electric power from the Hungry Horse project at the earliest possible date to help meet the growing power requirements of the Pacific North-West. The completion of the Hungry Horse project will add 285MW of installed capacity at the dam and will increase by more than 500MW the firm capacity of downstream plants.

Development of Natural Resources in Alaska

A detailed report on the development and the multi-purpose use of the natural resources of Alaska has been submitted to Congress by the U.S. Department of the Interior. In summary, the report presents five major conclusions for the consideration of Congress in planning the economic future of Alaska: (1) The demand for electric power supply in Alaska is expanding so rapidly that new installations of hydro-electric power plants are needed to meet the requirements of the civilian and military population in the Anchorage and Fairbanks area; for additional military installations in the vicinity of Anchorage, Fairbanks and Nome, and to provide the power necessary for the full utilisation of the natural resources of the territory. (2) Adequate agricultural production is necessary to the economic life and future development of Alaska. Present production is inadequate; to increase agricultural production an immediate investigation is recommended of the physical and economic feasibility of bringing approximately 87,000 acres of new agricultural land into production as soon as possible. Surveys are required on the engineering and economic feasibility of land clearing, reclamation by land drainage and irrigation projects. (3) Municipal and industrial water supplies are urgently needed in several localities, particularly in the Fairbanks area, where well water is contaminated by contiguous cesspools. (4) Flood control and navigation of inland waterways in Alaska will increase in importance as the territory is developed. The investigations of water resources to be accomplished in Alaska by the Bureau of Reclamation would be complemented by the investigations in Alaska authorised to be made by the U.S. Army Corps of Engineers under the American Flood Control Act of 1948. It is advocated that the Bureau of Reclamation and the Corps of Engineers should jointly consider these problems in connection with irrigation, power and other multiple-purpose project investigations.

The report suggests that immediate investigations of the water resources for power and multiple-purpose benefits should embrace the Big Susitna River Basin; the transmountain diversion of water from the Lewes River (Yukon) drainage basin in Canada with its chain of lakes to the Taiya River outlet ten miles north of Skagway, Alaska, and other potential power sites in the south-east where interested pulp industries are investigating the possibilities of establishing pulp mills. The first Federal power plant in Alaska is under construction on the Eklutna project, authorised by Congress in 1950 to provide 143,000,000 kWh of hydro-electric energy for the Palmer and Anchorage areas. The project will carry water in a 4½-mile-long tunnel through Goat Mountain from Eklutna Lake to a 30MW plant on Knik Arm Flats. Reconnaissance studies in the territory have indicated that there are at least seventy-two potential sites for hydro-electric generating plants in Alaska, which could produce about 50,000,000,000kWh of energy for industrial and economic development. One of the proposed dams on the Wood Canyon site on the Copper River in the South Central Region would be 700ft high. The proposed reservoir on the Kushkokwim River in the Yukon region of South-Western Alaska would provide storage space for 230,000,000 acre-feet of water, as compared with the 32,000,000 acre-feet in Lake Mead at Hoover Dam, and would require ten years to fill. Another reservoir, at Tuksuk, in the Seward Peninsular region, would store 4,500,000 acre-feet of water and take nine years to fill.

RADIO COMMUNICATIONS AND RADAR MEASURING INSTRUMENTS COMMITTEE.—Three associations, whose interests include matters relating to the development and production of radio communication and radar measuring instruments, have collaborated in the formation of a joint committee which will advise their respective councils on such subjects. The three associations are the Radio Communication and Electronic Engineering Association, the Radio and Electronic Component Manufacturers' Federation and the Scientific Instrument Manufacturers' Association. Membership of the joint committee, which is known as the Joint Advisory Committee on Radio Communication and Radar Measuring Instruments, is open to any member of the three associations who is concerned with the development or production of this class of measuring instrument. The committee will be able to consider both commercial and technical questions brought to its notice by members themselves, Government Departments and other external bodies. The committee is administered from the offices of the Radio Communication and Electronic Engineering Association, 59, Russell Square, London, W.C.1 (telephone, Museum 6905); the committee secretary is the assistant secretary of the above association.

Industrial and Labour Notes

The Trades Union Congress

The eighty-third Trades Union Congress opened at Blackpool on Monday morning last and has continued throughout the week. It is being attended by about 900 delegates from the 180 affiliated unions. Prior to the opening of the Congress, the general secretary, Sir Vincent Tewson, stated that, at the end of 1950, the total membership of the affiliated unions was 7,827,945, which was 55,410 less than at the end of 1949.

Mr. Alfred Roberts is the president of the Congress, and in his address, which was delivered on Monday morning, dealt with the implications of the rearmament programme. Last year, he said, the Congress recognised the need for rearmament, but the measure of the sacrifice the nation was called upon to make in the material sense was only now beginning to be realised. Having recognised the necessity for rearmament as a means of defence against aggression, the cost had to be carefully counted, for the task of rearmament was one that could only be undertaken within the limits of our real resources.

The implications of rearmament for the trade union movement, Mr. Roberts continued, were serious and far-reaching. The programme would involve a considerable amount of redeployment, and even perhaps some temporary unemployment in various industries and different localities. It meant the diversion of vast quantities of essential raw materials—bought at very high import prices—from the industries producing for civilian needs to the armament industries and related trades. The programme also meant an expansion of our export trades at the expense of home consumption in order to provide the resources required for the purchase of supplies, both of raw materials and food, in an inflationary phase of world economy.

Mr. Roberts went on to say that trade unionists themselves in their individual capacities could play a useful part in the adjustment of manpower to meet new demands. They could, for example, emphasise the necessity of using the placing service of the Ministry of Labour in filling jobs of national importance; they could help to give publicity to the scheme for early notification of redundancy so that jobs were quickly found and skill was not left idle, and, through their works committees, trade unionists could help to devise new methods of working to meet changes in demand and supply.

Finally, Mr. Roberts observed that the power which the trade unions had won brought its own responsibilities. They were not, he said, exclusively the responsibilities of union leaders, officers and executives, but must be shared by every single trade unionist if the movement as a whole was to retain its character and its influence as a progressive democratic force. It was impossible to mention that consideration, he remarked, without a reference to the unofficial strikes which had caused embarrassment and, in some cases, considerable dislocation of the efforts to meet all the obligations imposed upon the unions in the present national circumstances.

Changes in Wage Rates

The Ministry of Labour has stated that the changes in wage rates reported to have come into operation in the United Kingdom during July resulted in an aggregate increase estimated at £492,000 in the weekly full-time wages of about 1,595,000 workpeople. Among those receiving increases were workpeople employed in the iron and steel industry, in industrial canteens, and in municipal tramway, trolleybus and motor omnibus undertakings outside the Metropolitan area.

The increases in the iron and steel industry were payable under sliding scale arrangements based on the index of retail prices. In the municipal passenger and transport undertakings outside the Metropolitan area, national standard rates of wages were adopted for the operating staff, resulting in increases of 11s. or 13s. a week for drivers, and 10s. or 12s. for conductors, according to the former grading of the undertaking, and of 7s. 6d., 8s. or 8s. 6d. a week, according to occupation, for workers in depots and garages.

In the first seven months of this year, changes in wage rates resulted in increases aggregating £3,288,100 in the weekly full-time wages of 7,921,500 workers. There were no decreases in wage rates during that period. In the corresponding months of 1950 there was a net increase of £478,500 in the weekly full-time wages of 2,638,500 workers.

Railway Wages

Last week, the Railway Executive replied to the claim for a 10 per cent increase in wages which has been submitted jointly by the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen, and the Transport Salaried Staffs Association. After a meeting between representatives of the Railway Executive and the three unions on Tuesday of last week, it was stated that certain proposals were made by the Executive, which at the present juncture are not being disclosed. The meeting was adjourned until September 10th to enable the unions to examine the proposals.

Power Station Wages

At a meeting last week of the National Joint Council for the Electricity Supply Industry, agreement was reached over a wage dispute in the electricity supply industry. By the agreement, it is stated that the wages of about 120,000 manual workers employed by the British Electricity Authority are to be increased by 2d. an hour, the increase being retrospective to June 1st.

Last April, the unions put forward a claim for a wage increase of 10 per cent, which the British Electricity Authority was unable to grant. The Authority offered a 5 per cent increase, which, in turn, the unions rejected. Subsequently, there has been unofficial protest action in the form of bans on overtime by the maintenance workers at a number of power stations throughout the country. Since the settlement, which is understood to exceed the 5 per cent advance offered by the British Electricity Authority, the unions concerned have made a statement deprecating this unofficial action.

Manpower and the Rearmament Programme

The tenth report of the Select Committee on Estimates, which was published at at the end of last week, deals with various aspects of the rearmament programme. One section of the report reviews the manpower situation, reference being made to a memorandum from the Ministry of Supply, dated July 10th, 1951, which stated that considerable difficulty was already being experienced in securing a comparatively small number of skilled and unskilled workers. That difficulty was attributed partly to the retention of underemployed workers in certain industries such as the motor-car industry. It was pointed out that the shortage was notable in the aircraft and machine tool industries, and also on the railways, where in some areas the number of vacancies had increased from 12,137 on January 1, 1951, to 14,584 on May 19th.

The Select Committee goes on to say in its report that the shortage of skilled and technical manpower has grown more serious in recent months. According to information given to the Committee by the Ministry of Defence, in the professional and works staffs of the Service Departments the deficiency of professional staff is 370 out of a requirement of 1744 and the deficiency of technical staff is 1004 out of a requirement of 4613. The Committee noted with interest the Ministry of Labour's view that a skilled man normally increases his skill during his period of service with the forces because he is put into the appropriate service trade where he continues to do skilled work.

On scientific staff, the report says that the great majority of scientists, including those of the foremost quality, are engaged upon research and development for the current defence programme, whereas the ideal would be for many of them to be occupied on projects which would not be developed for another ten years. Some 1750 scientific workers are urgently needed over the next two or three years, and the recruitment of them, the Select Committee comments, is very difficult. The problem of working out satisfactorily attractive conditions of service is under "urgent consideration." The Committee says that evidence recently received reinforces the need, expressed in an earlier report, for definite action to solve the problems of recruiting scientific staffs.

Labour in the Coal-Mining Industry

The Minister of Labour, Mr. Alfred Robens, gave the closing address to the National Coal Board's annual summer school at Oxford on Friday evening last, August 31st. He spoke on the labour problems of the coal-mining industry, saying in the course of his address that, no matter what might be done with regard to mechanisation, manpower was the key to the coal production problem. It was clear, Mr. Robens observed, that there was not sufficient manpower available in this country to do all the tasks that required to be done, and, provided there was the guarantee that no foreign worker should take a job for which there was a British worker, there should be no opposition to finding a job for an unemployed worker from another country.

In another part of his address, Mr. Robens stressed the importance of making the best use of the joint consultative machinery which exists in the coal-mining industry. There was, he said, nothing more wasteful of human labour than an interruption of work owing to a dispute. Last year, there were 1600 cases of strikes or "go slow" movements in the industry and they cost over 1,000,000 tons of coal. He argued that, on the whole, the carefully devised joint consultative machinery had worked very well. Indeed, Mr. Robens stated, the average annual loss of working days in coal-mining, owing to disputes, had been, in the last five years, less than two-thirds of the annual average for the five years 1935 to 1939. Nevertheless, he added, there were 431,000 working days lost through disputes in 1950, and that was 431,000 too many.

Steel Company Directorate Changes

The Iron and Steel Corporation of Great Britain has announced the reconstitution of the boards of two publicly owned iron and steel companies, the Park Gate Iron and Steel Company, Ltd., Rotherham, and the Darwen and Mostyn Iron Company, Ltd., Flintshire. The board of the Park Gate Iron and Steel Company, Ltd., consisted of three part-time directors and three full-time directors. In order to create a board "suitable for the future needs of the company," the Corporation, after consultation with the chairman of the company, arranged that two of the part-time directors, Sir Allan Grant and Colonel D. S. Branson, should resign and that two of the younger executives, Mr. T. Fairlie, works superintendent, and Mr. J. Wadsworth, staff and labour superintendent, should become directors of the company.

The board of the Darwen and Mostyn Iron Company, Ltd., consisted of the chairman and four part-time and two full-time directors. In order to create a better balanced board, the Corporation consulted the chairman of the company and arranged that two part-time directors, Mr. R. H. Storey and Mr. R. A. Storey, would retire, so that the board now consists of two part-time and two full-time directors under the chairmanship of Mr. Reith Gray.

Notes and Memoranda

Rail and Road

TRANSPORT USERS CONSULTATIVE COMMITTEES.—Under the provisions of Section 6 of the Transport Act, 1947, the Minister of Transport has appointed Mr. W. H. Powell, representative of industry, to be a member of the Transport Users Consultative Committee for the London area, in place of the late Mr. E. W. Rainer, and Mr. H. Smith, representative of commerce, to be a member of the committee for the East Midland area, in place of the late Mr. J. S. Blackmore.

4–6–4 LOCOMOTIVES FOR THE VICTORIAN RAILWAYS.—The North British Locomotive Company, Ltd., has drawn our attention to some errors in the article in our issue of August 24th, describing the locomotives built for the Victorian Railways. In dealing with the construction of the boiler barrel the note should have read: "the longitudinal seams are treble-riveted with inside and outside butt strips and the circumferential seams are double-riveted." At the front end the frame has a cast steel headstock incorporating the buffer beam and dragbox, and the back end of the frame consists of a one-piece cradle steel casting securely attached to the main frames at the rear of the coupled wheels. The note dealing with the pistons, later in the article, should have read: "The pistons are fastened to the rods by means of gunmetal nuts and split cotters and the crossheads by tapered cotters each fitted with a split safety cotter."

Air and Water

INTERNATIONAL COLLISION REGULATIONS.—Acceptances of the International Regulations for Preventing Collisions at Sea, 1948, have been notified by twenty-nine countries representing merchant fleets totalling 40,000,000 gross tons. It is hoped to fix a date shortly, on and after which the regulations must be applied.

IMPROVEMENTS AT WELSH DOCKS.—The Docks and Inland Waterways Executive has received an expenditure authorisation totalling £525,000. The existing steam pumping plant at the commercial graving dock, Cardiff, will be replaced and a power station at Queen Alexandra Dock electrified. At Swansea, electrical services are to be reorganised and electrically-driven turbo pumps substituted for certain steam and hydraulic power units. A new ring main is to be installed at Newport and electric pumps substituted for existing steam plant at the South Lock power station.

Miscellanea

CONTROLLER OF ATOMIC ENERGY.—The Minister of Supply has appointed Lt.-Gen. Sir Frederick Edgworth Morgan, K.C.B., Controller of Atomic Energy. He will take up his duties on October 1st, when the present Controller, Lord Portal of Hungerford, will relinquish his post.

OIL IN CANADA.—Next month there is to be a meeting of oil experts at Edmonton, Alberta, Canada, to consider the development of the oil resources in Canada, with particular reference to the extraction of oil from the bituminous sands of the Athabasca River region of Alberta. The area could also produce large quantities of sulphur by refining the bitumen content of the sands.

BUILDING APPRENTICES.—A report made by the Building Apprenticeship and Training Council to the Minister of Works states that the building industry is likely to suffer from a shortage of properly trained apprentices. Energetic recruiting, fuller support by employers of the National Apprenticeship Scheme and proper indenturing and registering of apprentices are recommended as remedies.

SYMPOSIUM ON PRESTRESSED CONCRETE STRUCTURES.—The Cement and Concrete Association has announced that the symposium on prestressed concrete structures, which will take place on September 24th and 25th, is to be held at the Institution of Civil Engineers. The title of the symposium has been changed to "Prestressed Concrete Statically Indeterminate Structures." Further details may be obtained from the Association, 52, Grosvenor Gardens, London, S.W.1.

PETROLEUM TERMINOLOGY.—The Nomenclature Sub-Committee of the Standardisation Committee of the Institute of Petroleum is preparing a glossary of petroleum terms, suitably defined for those not versed in the technicalities of petroleum. The Sub-Committee is still working on the glossary, but as an interim measure has issued the first part of its work in booklet form. This booklet of sixteen pages deals with the more widely known petroleum products and terms used in the industry and gives definitions of 117 items.

ELECTRICAL EQUIPMENT FOR CANADA.—The British Standard Institution draws attention to the fact that many British manufacturers, interested in the Canadian market, may be unaware of the facilities which have been established under the ægis of the Institution to facilitate approval of their equipment for export to Canada. No fewer than 220 applications for Canadian Standards Association approval were received by the B.S.I. during the first year's operation of a scheme to speed up approval of U.K. electrical equipment intended for the Canadian market.

INTERNATIONAL SCIENTIFIC FILM CONGRESS.—The fifth congress of the International Scientific Film Association is to be held at The Hague, Holland, from September 15th to 22nd. During the congress the research film committee of the Association is hoping to show many photographs of special applications of scientific cinematography and the apparatus used in research film making. Anyone who can contribute to the British section of the exhibit is asked to communicate as soon as possible with the Scientific Film Association, 4, Great Russell Street, London, W.C.1. Similarly, if anyone has information about interesting work being done in this country, they are invited—having obtained the necessary permission—to pass on that information.

BARKING-ILFORD UNDERGROUND CABLE INSTALLATION.—We learn that good progress has been made with the British Electricity Authority's 132kV underground cable installation between Barking and Ilford. It will be the largest installation of its kind yet undertaken in this country. The contract, which is in the hands of British Insulated Callender's Cables, Ltd., calls for the supply and installation of 9000 route yards of two three-core, 0·6 square inch, 132kV, impregnated pressure cables, associated auxiliary cables and a quantity of three-core, 0·06 square inch, 33kV solid type cable. When completed, these underground transmission lines will provide a major reinforcement to the existing electrical network in the Ilford, Chigwell, Woodford and Buckhurst Hill districts—the districts which comprise the north-east corner of the London Electricity Board's area and which have been extensively developed during recent years as residential and light industrial areas. The existing electricity supply, apart from about 3000kW generated at Ilford, comes from Barking power station over 33kV feeders, some of which are operated at 22kV. The new 132kV lines will be connected at the Barking end of the installation to the switch-house now being built in conjunction with the power station extensions at Barking "C." The new lines will provide a major outlet of load from Barking and, at the Ilford end of the installation, will be connected to a new substation, where the voltage will be stepped down to 33kV and distributed over 33kV cable to the surrounding districts.

NEW STANDARDS FOR SERVICE BATTERIES.—The Ministry of Supply announces the publication of new standards for dry and inert Leclanché primary batteries for use by the Services and Government Departments laid down in the first of a new series of general specifications for Inter-Services equipment, prepared by the Engineering Standards Co-ordinating Committee of the Ministry of Defence. The main requirements for batteries for the Services is that they must be unaffected during storage, transport and operation by extreme climatic conditions in any part of the world. They must also be able to stand up to severe vibration and mechanical shock. To meet these needs, the new specification lays down standards for the design, manufacture, test procedure, type approval and inspection of primary batteries generally. Supplementary specifications, when prepared, will govern special requirements for individual kinds of batteries. Standards established by the specification for materials used and the manufacture of batteries include provisions that carbon rods must be treated to prevent electrolytic creep, zinc cans must be of seamless construction, inter-cell connections must be made with tinned copper conductors, insulated where required, and cells and materials for container and inter-cell insulation must pass tests detailed in the specification. Performance tests for storage in temperate, jungle and desert climates, and discharge tests are laid down in the specification, and inspection procedures are also detailed. Under the provisions of the specification all batteries must be marked indelibly with Inter-Service reference numbers, manufacturers' identifications signs and the date of manufacture. Copies of the specification (DEF-1—General Specification for Primary Batteries) are obtainable from H.M. Stationery Office, price 1s.

BRITISH MACHINE TOOL DEMONSTRATION IN AMERICA.—An open invitation has been issued to British manufacturers of production equipment to exhibit and demonstrate their machine tools, accessories and allied equipment to American industrial executives and engineers at the ninth biennial industrial exposition to be held in Chicago, in March next year. This exhibition is sponsored and organised by the American Society of Tool Engineers, a technical society of 19,000 engineers and executives concerned with manufacturing processes and equipment, in the United States and Canada. The secretary of the society states that the decision to invite British manufacturers of equipment to participate in the exposition is based on the marked need for relieving the current and increasing shortage of machines and tools in the United States. British manufacturers who already have American representation can arrange for space through their representatives. Others may make application direct to the ASTE Industrial Exposition, American Society of Tool Engineers Building, 10700 Puritan Ave., Detroit 21, U.S.A.

Personal and Business

MR. P. HAY has become a sales engineer at the Manchester sales office of Lancashire Dynamo and Crypto (Mfg.), Ltd.

COLONEL J. READING, B.Sc. (Eng.), M.I.E.E., Staff Engineer at the General Post Office, has been appointed Assistant Engineer-in-Chief.

MR. C. L. G. FAIRFIELD, M.A., A.M.I.Mech.E., A.M.I.E.E., Barrister-at-Law, has been appointed manager of the valve division of Mullard, Ltd.

THE RAILWAY EXECUTIVE announces the appointment of Mr. M. G. R. Smith, B.Sc., M.I.C.E., as civil engineer, Western Region, from November 10th.

MR. J. S. SKINNER has been appointed controller of office equipment sales for Remington Rand, Ltd., Commonwealth House, 1–19, New Oxford Street, London, W.C.1.

THE BRITISH BROADCASTING CORPORATION announces the appointment of Mr. F. C. McLean as acting assistant chief engineer, in view of Mr. H. L. Kirke's prolonged absence on sick leave.

MR. JAMES DOW, formerly of De la Rue (Thomas) and Co., Ltd. (Plastics Division), has joined the technical sales side of R. H. Windsor, Ltd., Royal London House, 16, Finsbury Square, London, E.C.2.

COOPER AND CO. (B'HAM), Ltd., states that its main administrative offices have been transferred to the factory at Brynmawr, Breconshire (telephone, Brynmawr 312; telegrams, "Felting" Brynmawr). The factory and registered office at Little King Street, Birmingham, 19, are being retained.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, Ltd., announces the retirement of Mr. T. H. F. Willoughby, chief accountant, and Mr. S. Stansbridge, manager of the traffic division. Mr. F. H. Reeves has been appointed chief accountant, and Mr. W. Hill, deputy chief accountant.

THE PULSOMETER ENGINEERING COMPANY, Ltd., Reading, states that Sir Felix Pole, Mr. R. G. W. Bliss and Mr. A. V. Price have been appointed directors. Sir Felix Pole will preside at board meetings in place of Mr. Eliot Hodgkin, who has resigned. Mr. J. Elliott has been appointed secretary of the company.

MR. L. A. FERNEY, B.Sc., M.I.Mech.E., formerly assistant scientific adviser to the Air Ministry, and Tube Investments Research Fellow in Engineering Production, University of Birmingham, has now set up in practice as an industrial consultant under the style of L. A. Ferney and Associates, 93, Westbourne Terrace, London, W.2 (telephone, Paddington 9604).

POWELL DUFFRYN, Ltd., announces that, for reasons of health, Mr. J. P. S. Clarke has asked to be relieved of the chairmanship of Stephenson Clarke, Ltd., and Associated Coal and Wharf Companies, Ltd., and of his membership of the management committee of the Powell Duffryn board. Mr. Clarke will continue to serve as a director of Powell Duffryn, Ltd., and other associated companies. Mr. E. W. Ganderton will take Mr. Clarke's place upon the Powell Duffryn management committee, and as chairman of Stephenson Clarke, Ltd., and Associated Coal and Wharf Companies, Ltd. Sir Henry Wilson Smith, K.C.B., K.B.E., has been appointed a director and vice-chairman of Stephenson Clarke, Ltd., and has joined the board of Associated Coal and Wharf Companies, Ltd. Both Mr. Ganderton and Sir Henry Wilson Smith are full-time directors of Powell Duffryn, Ltd.

British Patent Specifications

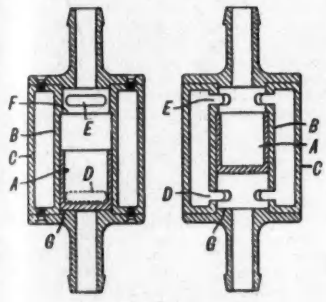
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

VALVES

655,711. October 21, 1948.—Valve Improvements, John Edward Coleman, 30, Braintree Road, Witham, Essex.

The invention relates to non-return and safety or release valves. In the accompanying drawing the left-hand view shows a cross section of a non-return valve with its piston in the closed position, and the right-hand view shows the piston in the open position. A piston *A* made of stainless steel can slide within the inner wall *B* of the hollow double-walled valve body *C* which is made of phosphor-bronze. The inner wall of the body has inlet ports *D* at one end, outlet ports *E* at the other end, and a shoulder *F* near the outlet ports. The end cover plates are screwed to the valve body and have tubular inlet and outlet connections for coupling to a pipe or tube carrying the liquid, whose flow is to be controlled. In the closed position the piston seats on to the boss *G* in the lower end cover plate. In operation, with the assembled valve connected



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so that the liquid enters the lowermost tubular connection, suction applied to the top connection moves the piston and causes it to travel until the shoulder *F* prevents further movement. In this position the piston has exposed the inlet ports *D* so that the liquid can now flow through the inlet ports into the annular space in the body which it leaves through the outlet ports *E*. When the suction ceases, the piston fills with liquid and is forced on to the seating formed by the boss *G*, thus closing the inlet ports. The specification also shows a safety valve of similar construction to the non-return valve. In this valve the movement of the piston compresses a helical spring inserted between a disc within the body and the piston.—*August* 1, 1951.

METALLURGY

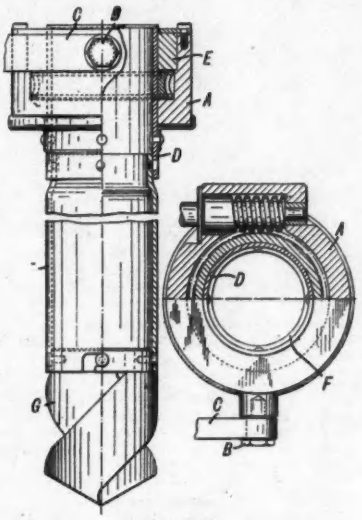
655,514. October 28, 1948.—Surface Treatment of Aluminium or Aluminium Alloys, Louis Progoniker, Laboratoire Industriel et de Recherches Electroniques, 14, Rue Pierre-Brossolette, Chatillon-sous Bagneux (Seine), France.

The invention has for its object an electrolytic process for the treatment of aluminium or aluminium alloy, especially to promote brightness and polish. It permits the use of alternating current at a low voltage. It has been found that a current density between 200A and 300A per square foot and a concentration of the alkali metal cyanide of 90g to 110g per litre give satisfactory results. It is necessary also to include in the bath a retardent to soften down the action of the alkali metal cyanide, and for this purpose an alkali-metal sulpho-cyanide or sulphate has been found effective. The current employed is an alternating current and may conveniently be used at 15V with a current density of 250A per square foot of work surface. The time the work is submitted to this treatment should not exceed three minutes; in practice it has been found that a period of fifteen to twenty seconds for a machined surface is sufficient to obtain a bright surface on the metal. The temperature at which the treatment is carried out is preferably between 50 deg. and 100 deg. Cent. Temperatures from 130 deg. to 140 deg. Fah. serve particularly well. If the temperature is allowed to drop lower than about 50 deg. Cent. secondary reactions apart from the electrolytic action are liable to set in and cause inferior surfaces. The process also has the effect of degreasing and cleaning the object treated. A bath suitable for carrying out the treatment consists of sodium cyanide, 100g per litre; sodium sulpho-cyanide, 15g per litre; gelatine, 5g per litre. With this bath the work may be subjected to a current at 15V with a current density of 250A per square foot of work surface for fifteen to twenty seconds. The process enables a bright polished surface to be obtained on the aluminium at low cost and very rapidly, and the bath requires very little attention over long periods before any renewal is necessary.—*July* 25, 1951.

AGRICULTURAL ENGINEERING

655,933. May 11, 1946.—Devices for Cutting Holes in the Ground, Leslie Norman Weekes, Wardsdown Farm Nurseries, Flimwell, Sussex.

As shown in the drawing a main head casing *A* is pivotally attached at *B* to a pair of links *C*, which are adapted to be attached to the hydraulically or mechanically operated lift provided on the rear of certain types of agricultural tractors. The head casing has mounted within it a drill sleeve *D*, which is guided by the casing at its lower portion, and is guided within the casing at its upper portion by a bearing collar *E*. Keyed to the sleeve at an intermediate point is a worm pinion driven by a



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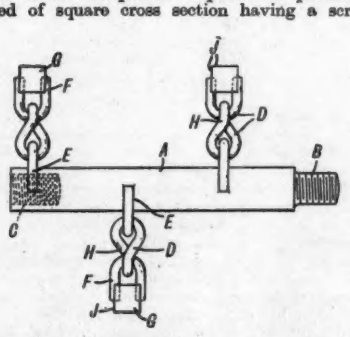
worm either manually or mechanically from the power take-off of the tractor. Attached to the lower portion of the sleeve *D* is an extension tube *F*, which at its lower end carries a drill bit *G*. The tube may be detachably secured to the sleeve so as to permit the use of interchangeable tubes and drills of different sizes. In operation the device normally hangs from links *C*, and when the tractor is in correct position the drill bit is lowered on to the ground and rotated, the feed of the drill being assisted by the power lift of the tractor. When the requisite depth is reached the drill is removed by the power lift. An alternative form of construction, in which the drill member comprises a tube formed of a number of longitudinal sections, is also described in the specification.—*August* 8, 1951.

MISCELLANEOUS

655,915. October 13, 1948.—Devices for Removing Deposit from the Walls of Pipes, General Descaling Company, Ltd., 289, Hanover Street, Sheffield, 3, and Leslie William Webb, of the company's address.

The device comprises a spindle *A* preferably formed of square cross section having a screw-



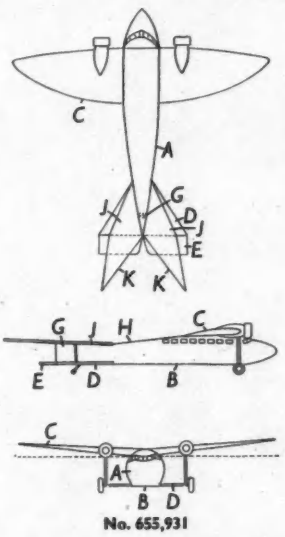
No. 655,915

threaded spigot *B* at one end and a complementary threaded socket *C* at the other end for connection with similar lengths of spindle when more than one length is required, or for connection to a driving shaft. The chain cutters comprise links *D* connected together like a chain, the link at the inner end conforming to a U with its limbs *E* embracing two opposite sides of the spindle, and welded to it, whilst the link at the outer end of the cutter is also of U shape with the free ends of the limbs *F* bridged by an insert *G* of "hard metal" such as tungsten carbide. Intermediate links may be twisted as shown at H. The insert is preferably in the form of a cube, as shown, so that its edges *J* constitute cutting edges for chipping away the deposit from the internal wall of a pipe.—*August* 8, 1951.

AERONAUTICAL ENGINEERING

655,931. March 8, 1949.—Improvements Relating to Aircraft, Resit Muhlis Erer, of 5/1, Toker Apartment, Karanfil Sokak, Cumhuriyet mahallesi, Yenisehir, Ankara, Turkey.

In the improved tail unit for aircraft, shown in the drawing, the fuselage *A* has its underpart formed as a plane surface *B*. The main planes *C* are mounted on the upper forward part of the fuselage and have a positive angle of attack of 3 deg. The surfaces *D* mounted at the rear of the fuselage are substantially in the same plane as the underpart *B* and are provided with movable surfaces *E* serving as elevators. The parts *D* and *E* together form the tailplane of the aircraft. A rudder *G* is mounted at the rear of the fuselage and extends upwards from the wings *D* to the upper surface *H* of the fuselage. At this part of the fuselage are mounted two fixed auxiliary



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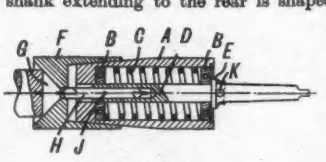
planes *J*. They have a negative angle of attack of 9 deg. measured from the upper surface *H* of the fuselage, and a dihedral angle substantially equal to that of the main planes *C*. The leading edges of the planes *J* slope backwards from the fuselage and meet their inclined trailing edges *K* to form a sharp tip. In flight the combination of the positive angle of attack of the main planes and the negative angle of attack of the auxiliary planes, together with their dihedral angle, improve the longitudinal and lateral stability of the aircraft. Further, these auxiliary planes also assure safety and efficiency when landing under abnormal conditions.—*August* 8, 1951.

TOOLS AND WORKSHOP APPLIANCES

656,354. January 7, 1949.—Centring Tools for Lathes, Clairabert Victor Roberts and Francis Louisa Wheeler, both of Victor Road, Dee Why, New South Wales, Australia.

As shown, the invention comprises a hollow shell *A* fitted with detachable bearings *B*, between the casings of which is mounted a coiled spring *C*, within which is positioned a drill holder or shank *D*. A portion of the shank extending to the rear is shaped for



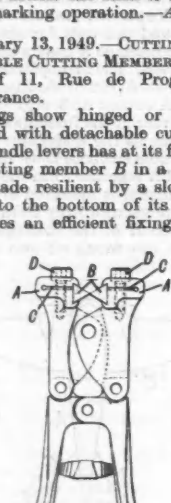
No. 656,354

securing the tool to a lathe headstock, and is fitted with a stop *E* to limit the backward travel of the shell on the shank. The front end of the shell is formed with a cup *F*, which has an open-faced frustro-conical depression *G* to take the end of an article to be marked; the central and longitudinal axis of the depression is in alignment with the

central and longitudinal axis of the shank, and with the similar axis of a centre drill *H* secured to the shank by a cotter pin *J*. As illustrated, the stop *E* is adjustable and has been moved forwards and locked by a setscrew in the hole *K* before the removal of the previously marked article; the cup in this form of construction is detachable and is a slide or drive-on fit on the shell. In operation, the shell having been moved forward, the article to be marked is mounted on the tailstock of the lathe and is moved backwards so that its end lies in, and in contact with, the walls of depression *G*; further rotation of the tool effects centring of the article in alignment with the centre drill, and as the article advances the shell slides backwards on the shank and drill *H* drills a hole in the article. The shell moves backward until stopped by *E*. On removal of the marked article the shell is moved forwards for the next marking operation.—*August* 22, 1951.

656,443. January 13, 1949.—CUTTING PLIERS WITH DETACHABLE CUTTING MEMBERS, Raoul Herckelbout, of 11, Rue de Progres, Montreuil (Seine), France.

The drawings show hinged or knuckle-jointed pliers furnished with detachable cutting members. Each of the handle levers has at its free end a jaw *A* to admit a cutting member *B* in a dovetailed slot. Each jaw is made resilient by a slot or saw cut *C* perpendicular to the bottom of its housing, and a screw *D* ensures an efficient fixing of the cutting



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member. Each cutting member can be fixed in its jaw in three positions so that its three edges may be used successively. Furthermore, if, as shown in the lower view, the length of each grip is greater than the width of the jaws, then, when the three edges of the end of the grips within the plane of the pliers are worn, the other end may be brought into use, and when all three edges at both ends are worn the grips can be removed and ground and reassembled for further use.—*August* 22, 1951.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Mon., Sept. 10th.—CENTRAL LONDON BRANCH: St. Ermin's Hotel, Caxton Street, S.W.1, "The Engineer and the Welfare State," R. F. Mathieson, 7 p.m.

Tues., Sept. 11th.—S.W. LONDON BRANCH: St. George's Hall, St. George's Road, Wimbledon, "Mercury Arc Rectifiers," C. H. Brown, 8.15 p.m.

Wed., Sept. 12th.—BRADFORD BRANCH: Midland Hotel, Bradford, "Modern Factory Lighting," A. G. Smith, 7.30 p.m.

Fri., Sept. 14th.—BRISTOL BRANCH: Grand Hotel, Bristol, "The Development of the Clyde Passenger Steamer," A. S. Miller, 7.30 p.m.——CREWE BRANCH: Crewe Arms Hotel, Crewe, "Limitations of Science," J. Levitt, 7.30 p.m.——NOTTINGHAM BRANCH: Old Angel Inn, Storey Street, Nottingham, "Power Cable Design," F. V. Howitt, 7.30 p.m.

Cement and Concrete Association

Mon. and Tues., Sept. 24th and 25th.—Institution of Civil Engineers, Great George Street, Westminster, S.W.1, Symposium, "Prestressed Concrete Statically Indeterminate Structures."

Engineers' Guild

Thurs., Sept. 27th.—Caxton Hall, Caxton Street, Westminster, S.W.1, Annual General Meeting, 6 p.m.

Incorporated Plant Engineers

Tues., Sept. 11th.—E. LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester, open meeting, 7.15 p.m.——GLASGOW BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, "Electronics in Production," 7 p.m.——S. WALES BRANCH: Institute of Engineers, Park Place, Cardiff, "Modern Applications of Rubber in Industry," 7.15 p.m.

Thurs., Sept. 13th.—E. MIDLANDS BRANCH: Evening works visit to Staythorpe Power Station.——KENT BRANCH: Queen's Head, Maidstone, "Electric Motors: Characteristics and Application," 7.30 p.m.——NEWCASTLE UPON TYNE BRANCH: Roadway House, Oxford Street, Newcastle upon Tyne, "Pulverised Fuel," film and discussion, P. R. Bettle, 7.30 p.m.——S. YORKSHIRE BRANCH: Works visit to Steel, Peech and Tozer's Steelworks.

Institute of Marine Engineers

Tues., Sept. 11th.—85, Minories, London, E.C.3, Junior Lecture, "Factors Governing the Design of a Modern Tanker with special reference to Machinery," W. Lynn Nelson, 7 p.m.

Tues., Oct. 2nd.—85, Minories, London, E.C.3, Presidential Address, S. F. Dorey, F.R.S., 5.30 p.m.

Institute of Petroleum

Wed., Sept. 19th.—Manson House, 26, Portland Place, London, W.1, "Our Unproduced Reserves: What are They?" Morris Muskat, 5.30 p.m.

Institute of Road Transport Engineers

Wed., Sept. 12th.—N.W. CENTRE: Visit to Hepworth and Grandage, Ltd., St. John's Works, Bradford, 2.30 p.m.——E. MIDLANDS CENTRE: Mechanics Institute, Nottingham, opening meeting of 1951–52 session, 7.30 p.m.

Tues., Sept. 18th.—MIDLANDS CENTRE: Crown Inn, Birmingham, "The Servicing of Brakes," J. Kinchin, 7.30 p.m.

Institution of Locomotive Engineers

Wed., Sept. 19th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Dynamic Braking for Steam, Diesel and Gas Turbine Locomotives," J. Koffman, 5.30 p.m.

Institution of Mechanical Engineers

Tues. to Thurs., Sept. 11th to 13th.—Storey's Gate, Westminster, S.W.1, General Discussion on "Heat Transfer," 10 a.m. each day.

Institution of Works Managers

Tues., Sept. 11th.—BIRMINGHAM BRANCH: Grand Hotel, Birmingham, dinner and annual general meeting, 7 p.m.

Sat., Sept. 15th.—NOTTS AND DERBY BRANCH: Visit to Power Station, Wilford Road, Nottingham.

Royal Aeronautical Society

Mon., Sept. 10th.—Royal Institution, 21, Albemarle Street, W.1, 39th Wilbur Wright Memorial Lecture, "The Well-Tempered Aircraft," A. E. Raymond, Douglas Aircraft Corporation, 6 p.m.

Thurs., Oct. 4th.—Institution of Civil Engineers, Great George Street, S.W.1, Seventh British Commonwealth and Empire Lecture, "Air Transport in New Zealand and the South Pacific," Air Vice-Marshal Sir L. M. Isitt, R.N.Z.A.F., 6 p.m.

Stephenson Locomotive Society

Sat. Sept. 8th to Sun. Sept. 9th.—Week-end tour of Motive Power Depots in Swansea and South Wales area.

Sat., Sept. 15th.—Visit to Ashford Locomotive Works and Running Shed, S.R., from 2.45 p.m.

Women's Engineering Society

To-day to Sun., Sept. 7th to 9th.—Nutford House, Brown Street, London, W.1, Twenty-ninth Annual Conference.

Contracts

THE COMMONWEALTH RAILWAYS OF AUSTRALIA has placed an order for fourteen diesel-electric locomotives of 955 b.h.p. for general service on the 3ft 6in gauge Central Australian Railway. The main contractor, the Birmingham Railway Carriage and Wagon Company, Ltd., will build the mechanical portion and deliver the complete locomotives. Complete technical responsibility is vested in Sulzer Bros., Ltd., and the diesel engines are to be supplied by Sulzer Bros. (London), Ltd., whilst the complete electric transmission and control equipment is to be supplied by Crompton Parkinson, Ltd.

THE WESTINGHOUSE BRAKE AND SIGNAL COMPANY, Ltd., has received a contract from the Eastern Bengal Railway for the double-wire resignalling of eight stations in Eastern Pakistan. Under this contract the stations of Shambhuganj, Gachihata, Nilganj, Shohagi, Ishwarganj and Nandail Road will be provided each with a sixteen-lever frame; Atharabari with nineteen levers and Kishorganj with twenty-four. For route and single-line control certain levers will be fitted with electric locks and/or circuit controllers; while sidings will be controlled by key locks, for which the keys are released from levers. Station masters' control slides will be required for the supervision of route selection and signal operation; double-wire point mechanisms, incorporating broken-wire locks, are to be provided; signal mechanisms and arm fittings for two and three-position signals, and double-wire compensators for simple and coupled transmissions.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

POWER-DRIVEN MOBILE CRANES

No. 1757 : 1951.—This is a new standard, which has been prepared to deal with road wheel mounted and tracked power-driven mobile cranes and it covers several different types. The types of crane dealt with include both the full slewing part-slewing and non-slewing types, which may be either fully mobile on their own wheels or tracks, or fully mobile and mounted on lorries. Semi-mobile types and portable cranes are also covered.

This standard follows lines similar to the other crane standards by indicating minimum requirements with the intention of securing the general observance of such fundamental principles as are desirable to ensure reliability and safety without hampering the freedom of the crane makers in their selection of the most appropriate design. At the same time guidance is provided for the user regarding the types of crane covered by the standard.

Eight types of crane are described and a number of the terms used in connection with them are carefully defined. A feature of the standard that should be of considerable assistance to the majority of crane makers and users is the comprehensive nature of the clause dealing with testing.

The clause dealing with factor of safety follows the conventional lines of other British standards for cranes but an appendix has been included dealing with stresses in struts, and this follows the general method of the application of the Perry-Robertson formula, which has been adopted in other appropriate British standards. Price 6s., post free.

THE ASSOCIATION OF SHORT CIRCUIT TESTING AUTHORITIES.—The Association of Short Circuit Testing Authorities (ASTA) was formed in 1938 for the purpose of co-ordinating the short circuit testing and certification of British switchgear and other apparatus. Its primary object has been to establish common standards of performance and testing, and since 1938 the various testing stations of the Association have accumulated a useful fund of information from their experience in short circuit testing. Because of the increasing interest taken in the work of the stations, some of this information has been embodied in publications to be made generally available, the titles being as follows:—ASTA No. 5, "Interpretation of Standard Rules Governing the Short Circuit Testing and Certification of Oil Circuit Breakers"; ASTA No. 6, "Interpretation of Standard Rules Governing the Short Circuit Testing and Certification of Low and Medium-Voltage Electric Fuses for Alternating Current Circuits"; ASTA No. 7, "Rules Governing the Short Circuit Testing of Circuit Breakers Which are Not Included, or Have Features Not Provided for in B.S. 116 : 1937 and B.S. 936 : 1940"; ASTA No. 8, "Rules Governing the Short Circuit Testing of High-Voltage Electric Fuses for Alternating Current Circuits"; ASTA No. 9, "Rules for the Short Circuit Testing of Circuit Breakers in Combination with Back-Up Fuses"; ASTA No. 12, "Rules for the Short Circuit Testing of Power Transformers, Current Transformers, Reactors, and Resistors." These documents fall into two categories: (i) interpretations of existing British Standards in relation to the short circuit testing of apparatus to ensure uniformity of test procedure and judgment of performance between test stations; (ii) rules for the short circuit testing of apparatus not yet covered by a British Standard to ensure uniformity of testing. All publications are of uniform size (9½in by 7½in) and, in general, each document covers information required by the testing authority for the purpose of identifying the apparatus to be tested; the information and results to be recorded by the testing authority; permitted deviations from the strict requirements of the appropriate specification(s) such as may be necessitated by the test plant limitations; and assessment of performance as judged by the behaviour of the apparatus during test and its condition after test. The "Rules" publications also include fundamental terms, method of rating and criteria of severity. In publishing the "Interpretations" the Association emphasises that in no way do these modify or conflict with any British Standard, but amplify such points as cannot, of necessity, be covered by a general standard specification. The "Rules" publications for apparatus not covered by British Standards are not intended to be final and will be subject to revision on the issue of such Standard. Copies of these publications are available on application to the Secretary, The Association of Short Circuit Testing Authorities (ASTA), 36, Kingsway, London, W.C.2, price 5s. each, post free.